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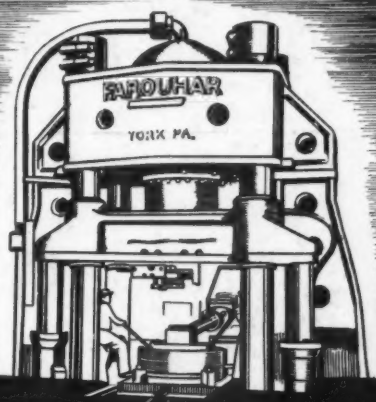

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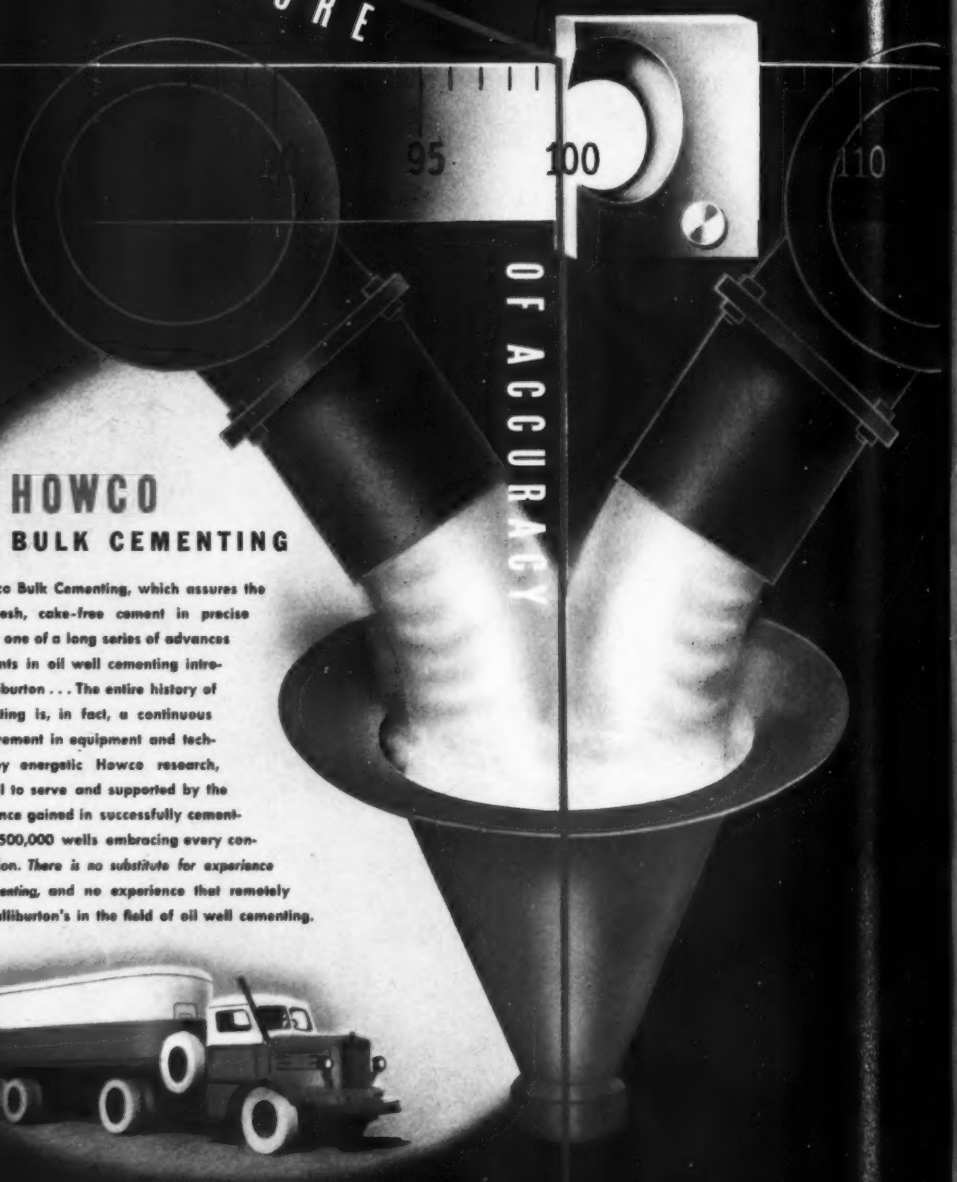

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THE OIL AND GAS JOURNAL

Applied Diplomacy

THE metropolitan press, news magazines, and radio reports are becoming increasingly conscious of oil developments in the Middle East. Comments are varied and too often lacking in factual data for essential background. Those of a leftist hue are doing their best to develop the viewpoint that the recently announced administration policy as regards Greece and Turkey springs from an unholy desire to protect American and British oil in the same general area.

Then there is the sincere question of some commentators as to whether those in charge of Middle East oil operations fully appreciate their political as well as operating responsibilities and possess that discernment as to the best course of action commonly credited to the professional diplomat.

We thought of these fears as we read the tributes paid to the late M. M. Stuckey, whose end came suddenly at Haifa, Palestine, a few weeks before his scheduled retirement after a lifetime spent in handling some of the oil industry's most difficult jobs. For several years he had been in charge of Middle East operations of Iraq Petroleum Co. and associated companies.

Stuckey would have been the last person to term himself a "diplomat," yet in a very real sense he was. He described his activities to the writer at the close of the war as those of a "has-been pipe liner whose job now is to get along with people and see that they get along with each other."

His company is jointly owned by British, Netherlands, French, and American nationals and all are represented in the management and operating personnel. Approximately 30 other nationalities are included in the thousands of employes who carry on the company's operations in several kingdoms and sheikdoms of the Middle East.

In that area where political confusion has been the rule for many centuries and where statesmanship has little to point to in accomplishment, this international organization has an esprit de corps in its personnel which amazes the visitor. Pride of workmanship takes precedence over social, political, racial, and religious differences in "I.P.C." activities.

An Arab pastor, who was one of the speakers at Anglican services for this American pipe liner, associated accomplishments with his personal virtues. He spoke of his modesty and his ability to "face his many responsibilities and heavy duties with an optimistic spirit." He "succeeded through his true democratic character in removing the barrier between employer and employe."

The peacemakers in Moscow and those who have UN responsibilities need have no concern as to Middle East operators. In fact, they might well send representatives there and to other oil centers scattered throughout the world to obtain the know-how of applied diplomacy.

Railroad Commission Boosts Crude Allowable in April Order

THE Texas Railroad Commission early this week issued an allowable order designed to give the state a daily average production of approximately 2,186,000 bbl. of crude during April.

The anticipated production under the order will be the highest since last summer when Texas was permitted to produce a reported 2,261,500 bbl. daily of crude in the week ended June 8, 1946.

The April order will allow a total production of 2,374,000 bbl. daily of liquid hydrocarbons, including natural gasoline and distillate. The 2,186,000 bbl. daily production of crude to be permitted under the April order will represent a substantial increase over output in the current month, which, for the week ended March 22, averaged 2,129,750 bbl. daily.

"Luckily, by reason of Texas wise conservation legislation through past years we can easily fill this all-time high demand for crude oil," said E. O. Thompson, commission chairman. The April order, Thompson continued, takes into consideration the cut recently ordered in Seeligson field production to curtail gas flaring, and the commissioners "have accordingly made other oil available to meet the market demand for Texas crude."

The April order provides for 26 general producing days in the 30-day month of April, compared with the current 27 for the 31-day month of March. There will be 22 producing days in East Texas field, compared with the present 21. District 8, West Texas, will continue on 18 days. Panhandle field is exempt.

The Bureau of Mines gave the commission an estimate of 2,120,000 bbl. daily April market demand for Texas crude. This was an increase of 60,000 bbl. daily over the March market demand estimate.

The allowable order usually follows the commission's monthly state-wide market-demand hearing, but this week's order was delayed since only Thompson was present at the March 19 hearing in Fort Worth.

Representatives of West Texas operators told Thompson at the Fort Worth hearing that their companies are pulling heavily on aboveground stocks of crude. Witnesses testified that West Texas pipe lines are running at capacity. Ralph Dietler, Tulsa, representing Stanolind, said new pump stations, to be completed in April, will raise capacity of the company lines from 80,000 to 86,000 bbl. daily. Purchasers' nominations for April crude order totaled 2,469,833 bbl. daily, up 32,464 bbl. daily over March nominations.

West Texas allowable is at present limited by pipe-line capacity. Pipeline companies have been asked to supply statistics to the commission showing maximum capacity and present volume being moved.

West Coast Crude, Products Increases Stir Political Controversy

AN increase of 20 to 25 cents a barrel in the price of crude oil, followed immediately by higher gasoline and other products prices, last week raised a storm of controversy in California.

California's Governor Warren, backed by various state legislators, termed the higher products prices a "plain steal" and an "insolent disregard for the welfare of the people" and said he will ask the antitrust division of the Department of Justice to investigate "not only the earnings of the companies involved but also their agreements and understandings for manipulating gasoline prices on the Pacific Coast to the injury of the public."

Warren charged the companies have connived to siphon off all the loose change of the people," and sabotaged pending highway-construction legislation.

Warren was answered immediately by an official for Standard Oil Co. of California, which initiated the new postings, and by the Oil Producers Agency of California.

The Standard official said: "Crude prices had to go up in order to assure production of the necessary oil for western states. Product prices are based now, as always, on the costs of doing business. We are sorry Governor Warren disagrees with our position."

In a 500-word telegram to Governor Warren, leaders of the California Oil Producers Agency criticized him for "confusing a political issue with an economic situation." The increase in the crude price, automatically followed by higher product prices, they said, "reflects an adjustment in part to compensate for pyramiding costs saddled upon the independent operators by higher wages, materials and services. The sequence of price increases for crude oil and refined products in California still lags behind the prices paid in the Mid-Continent and Mountain areas. . . ."

Before the California purchasing companies announced the crude increase, the Oil Producers Agency reported some of its members were advocating shutting in wells unless higher prices were obtained.

In its original crude-increase announcement, Standard of California said the price boost was made "to stimulate the search for much-needed oil in California and to bring California crude-oil prices more nearly in line" with prices elsewhere. It pointed out that two price increases totaling 35 cents a barrel have been made in other areas since California's last adjustment.

As announced by Standard, the new schedule increases oil of 20° gravity and above 25 cents a barrel, with a cent less increase for each degree of gravity down to 15 and below, which was given a 20-cent increase. The new price became effective March 19. Gasoline on the same day advanced 0.8 cent a gallon in Standard stations and similar increases were announced for other products. The increase brings the price of Signal Hill crude, 30°-30.9° gravity, to $1.86 per barrel.

Shell Oil Co., Inc., immediately followed Standard in announcing similar advances and was followed later by Richfield Oil Corp., Tide Water Associated Oil Co., Union Oil Co. of California, General Petroleum Corp. of California, and The Texas Co.

Drill Pipe Stuck in World's Deepest Well

The world's deepest oil well, Superior Oil Co. 51-11 Weller, NW NW NE 11-8n-12w, Caddo County, Oklahoma, has reached a total depth of 17,236 ft. A good show of oil was reported in the Mississippian at an estimated depth of 15,900 ft. High-pressure gas was encountered at 16,300 ft., and 7-in. casing was set at 16,351 ft.

At present efforts are being made to free the drill pipe which is stuck at 17,211 ft. Started just 1 year ago, this is the first serious difficulty encountered. *(Engineering features of this well are described in a special section beginning on page 160, this issue.)*

Healthy Refining Industry Indicated, Swensrud Tells W.P.R.A.

by Arch L. Foster

SAN ANTONIO, Tex. — Barring a substantial depression it appears that for the next several years at least it is not likely that any significant over-capacity in refining will exist, and therefore the basic supply and demand position should be sufficiently favorable to enable the refining industry to earn the kind of return that it must have to remain on a self-sufficient and replacement-cost basis, Sidney A. Swensrud, executive vice president, Standard Oil Co. (Ohio), told members of the Western Petroleum Refiners association at its thirty-fifth annual meeting here March 24-26.

A record attendance registering within the first few hours of the meeting signifies the great interest of refiners in the solution of the numerous problems which they face in all directions. Discussions at the meeting included the economic trends of the industry, synthetic chemicals, trends in product demand, crude supplies, the tendency of refining and all other costs to increase rapidly, and the requirements for old and new products along with changing demands which change the refiner's balance sheet.

Confronted by differing opinions regarding the proper margin of stocks of crude which is best for the industry over-all, Swensrud took mild issue with some crude producers by pointing out that the "border zone between state regulation on the one hand and operation of ordinary competitive factors on the other" might be "said to be represented by crude oil stocks" and that enough flexibility in the interest of promoting sound coordination to cushion the relationship between regulation and competition. The speaker pointed out that not only have forecasts for expected crude consumption and product demand been underestimated by 300,000 bbl. per day but that disagreement exists between authorities as to what should be done about crude stocks. The Interstate Oil Compact Commission has urged higher stocks while the I.P.A.A. committee on demand says stocks are too high. Swensrud believes that demand for all products will hold at a high level for several years and that old cars will not go off the road as fast as new ones are built.

Trends in varying demand for different products is upsetting the refiner's balance sheet of products from crude. Gasoline production at the highest yield is not good operation; a 45 per cent yield from total crude of prewar days has fallen to less than 40 per cent, he stated. Demand for heating and burning oils, and other intermediate products long thought of as byproducts is increasing, and the refiner must plan his operations in the light of these new demands, Swensrud said. Wartime activities promoted our ability to plan intelligently.

Gasoline quality in the light of catalytic-cracking possibilities complicate our future picture, he stated. Refiners having no catalytic-cracking units have trouble making the highest competitive grades of motor fuel. There may be a trend toward a lower octane rating for some time. A third-grade gasoline may again become strong in the market, he intimated. Estimates of renewal costs for refineries without catalytic-cracking facilities have been given prewar as ranging from $400 per barrel for a 5,000-bbl. daily unit to $270 per barrel capacity for a 60,000-bbl. daily plant. The postwar cost of a refinery of the larger size may be two and one-half to three times as much, or $40,000,000 to $50,000,000. Refiners must have adequate margin of return from operations to finance such refineries, and must have the return in the face of a 50 per cent increase in labor costs, the increased cost of crude production and its supply to the refinery. On the large refinery costing $40,000,000 the depreciation will be about $64 per year per daily crude barrel, or about 17 cents per barrel processed; interest on investment will run this extra cost up to 26 cents per barrel, he said. Swensrud believes that refiners have about reached their limit in raising throughput of existing refineries in order to cut unit operating costs and must adjust their concepts of costs and margins.

Petrochemical's Amazing Growth

The petrochemical industry is growing by leaps and bounds, M. B. Chittick, of Pure Oil Co., told the refiners. Incomplete figures for 1946 show an estimate of 4 billion pounds of synthetic organic chemicals, and a total for organic chemicals of 13½ billion pounds, of which petrochemicals compose about 28 per cent with a value of $250,000,000, he stated.

Remarks of the W.P.R.A. President

ONE of the opening speakers at the thirty-fifth annual meeting of the Western Petroleum Refiners Association was H. T. Ashton, St. Louis, general manager of the Lubrite Division, Socony-Vacuum Oil Co., Inc., and president of the association. His remarks, in part, follow:

H. T. ASHTON

"During the past winter we have experienced the most unusual demand for all refined products ever witnessed in the history of the industry during peacetime. From present indications, the summer season just ahead of us will show a greater consumption than last year and will tax the capacity of the industry.

"We must expand and improve to keep pace with changing conditions. Old equipment must be modernized and new facilities installed. New crude-oil reserves must be discovered, and our transportation systems expanded. The petroleum industry has the 'know-how' to accomplish these objectives and under a system of free enterprise, and with a realistic national oil policy, will meet the requirements of the future.

"The changing international situation brings new problems and increased demands upon the industry; we can no longer be content with just meeting the demand in the United States. The pattern must be cut to fit international conditions. To accomplish this, we must look to better relations between labor and management.

"Of great importance to the petroleum industry today is the matter of public relations. Too few people outside the industry realize and appreciate the many hazards of conducting such a vast business; the huge financial investment necessary, and the numerous and diversified talents that go into the manufacture of every gallon of petroleum products. Too few people realize that these products are the cheapest essential commodities on the market today."

U. S. Tariff Commission reports that for 1945 we produced 3.3 billion pounds of petrochemicals; in 1944 we made 2.8 billion pounds. This list includes some 14 different main products with various others in smaller quantities.

The refiner has a good place in this industry, Chittick believes, but urges them to "proceed with caution when considering entering it." The refiner should study his crude and production then survey the possible market for any products he can make, before going further with plans. One limiting factor may be the economics of collecting raw material which may be found in small amounts in several refineries but in each too small to make operations on the one output profitable, he pointed out. Petrochemical products may be divided into two classes: the older products such as naphthas, waxes, hydrocarbons; the second class includes those products made by synthetic methods from petroleum raw materials. Among the products which are now in short supply the naphthenic acids, fatty acids, cresylic acid, petrolatums, aromatics, mercaptans, and pure hydrocarbons. Glycerol is in great demand, off 25,000,000 lb. in production below requirements, Chittick stated.

Demand for intermediate fractions in the diesel-fuel range will be greater in future than the supply of straight-run products available, so it is necessary to study actual requirements and the properties of available materials, the diesel-fuel committee of the association reported. A survey of specifications and requirements of railroads and engine builders is completed, and copies are available on request. Fuel specifications for test products are being studied; the diesel-fuels division of the Coordinating Research Council is cooperating under Chairman W. G. Ainsley, Sinclair Refining Co. While the U. S. Bureau of Mines is studying the chemical composition of fuels of high and low sulfur, cetane number, etc., from representative crudes.

Another speaker was Ralph Champlin, Ethyl Corp., representing the public-relations committee of the oil industry. He reported the committee has divided the country into five districts which include 13 areas. Support for the program will be asked from 175 trade associations in 1947, he said.

"Petroleum and Natural Gas—Uses and Possible Replacements" was discussed in a paper by Dr. R. E. Wilson, chairman of the board of Standard Oil Co. (Ind.) and J. K. Roberts, general manager of research for Indiana Standard.

"Careful surveys indicate that present main uses of liquid fuels will expand and that the petroleum industry will therefore continue to be a 'growth' industry," Roberts said. "Automobiles will increase in number and will continue to be driven by gasoline. Although improved design will increase the efficiency of the engines, this advantage will be taken largely in the form of greater driving flexibility, instead of greater mileage per gallon; and with better roads available, there will be more driving per car, and at higher speeds.

"It is therefore expected that the annual consumption of gasoline per car will continue to rise slightly. Commercial vehicles will increase in number at an even faster rate than passenger cars, and annual use of gasoline per commercial vehicle will probably increase 30 per cent by 1970. Diesel equipment will be used more widely, particularly on the railroads and for sea-going vessels. Use of oil heaters for homes is expected to double the 1940 figure by 1950 and almost to treble by 1970, by which time more than 20 per cent of the one and two-family homes in the areas using central heat will be heated by oil.

"Increases in these methods of using liquid fuels will be the principal factors in an anticipated 1970 demand for 2,600,000,000 bbl. of crude oil or its equivalent—56 per cent more than the 1945 demand," Roberts continued.

Product Quality to Increase

"Quality of the products will also increase, particularly as regards the gasoline needed for higher-compression engines. The necessary higher octane number will become increasingly harder to supply. During the war, the high-octane cream could be skimmed off at the expense of the regular gasoline left behind. When all gasoline must be upgraded, expensive processing will be needed to make high-octane components ...

"The strong competition in the petroleum industry, plus the wide use of scientific research, has steadily improved the quality of products and at the same time has reduced the cost ...

"This achievement has been possible, however, only through larger and larger capital expenditures, and future advances will require still more expensive equipment. Based on 1947 construction costs, the investment required per barrel per day of product has risen as follows, with increases in the complexity of the operations:

	Investment required per daily barrel of product	
	1939 costs	1947 costs
Skimming	$180	$300
Topping and thermal cracking	600	1,000
Topping and catalytic cracking	900	1,500
Synthetic oil from natural gas	2,100	3,500
Synthetic oil from coal	3,000	5,500

"The use of capital for this necessary equipment and for the higher costs of finding oil should not be discouraged by government policies which prevent an adequate return on the investment required. Given the right environment, the petroleum industry feels confident it can maintain the country's supply of vitally necessary liquid fuels and lubricants at reasonable costs for many generations to come."

Stanolind Repressuring Project Set for Hearing

AUSTIN—The Texas Railroad Commission has set for April 8 a hearing on a petition of Stanolind Oil & Gas Co. to initiate a gas-repressuring program in Goldsmith field, Ector County. Stanolind asked permission to use six wells in the repressuring project and to have the allowable of these wells prorated to other producing wells.

The commission recently authorized Fain & McGaha to institute a project to the Strawn sand series in Daume field, Archer County, and to the Parkey sand and the Oolitic lime in East Holliday field, also in Archer County.

Gas, Oil Take 2 Per Cent Of Nation's Expenditures

An average of $18 was spent on gas and oil by consumers in the United States during 1946, according to a report by the domestic distribution department of the Chamber of Commerce of the United States. The figure represented 2 per cent of a total per capita expenditure for goods and services during the year of $900.

In its distribution news letter, the organization estimated there will be 240,000 service stations operating in the country in 1947, an increase of 31 per cent since 1943 and that they will do an average business of $16,000 this year.

Secondary-Recovery Results Described in Bureau Report

WASHINGTON.—Thirteen million barrels of the 17,000,000-bbl. production since 1925 in the eastern part of Delaware-Childers field, Nowata County, Oklahoma, are credited to secondary-recovery methods in the Bureau of Mines Report of Investigations 4,019.

The report indicates production of 23,000,000 bbl. by primary-production methods between 1906 and 1925, with a recoverable reserve of only 4,000,000 bbl. left in 1925 by primary-production techniques. Since secondary recovery was initiated in 1925, more than 51 billion cubic feet of air and gas have been injected into the Bartlesville sand through 500 selected injection wells. There is still 28,000,000 bbl. of recoverable oil in the area, based on calculations of oil saturation in cores, the report indicated.

this week

NATURAL GAS—Louisiana's legislature approves resolution junking 1942 declaration which gave the state its official policy in opposition to exports of natural gas. . . . Action by the state senate closes the office of gas conservation which carried out the antiexport policy. . . . ¶Trunkline Gas Supply, new company headed by Ralph K. Davies, asks FPC approval of proposal to build an 855-mile, 30-in. gas line from the Texas Gulf Coast to near Keokuk, Iowa. . . . The line would cost $74,266,000 and would serve principally other interstate pipe lines crossing its route. . . .

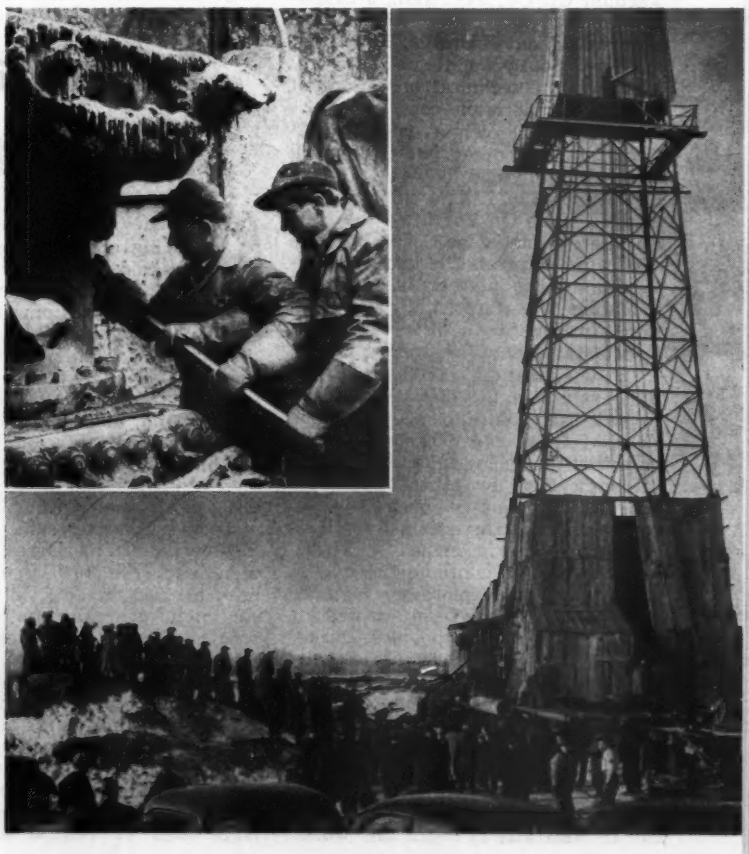
PRICES— Action of California companies in raising products prices following an advance in crude brings charges from the state's governor that the companies are "sabotaging" a highway-construction program. . . . Producers association declared governor confuses a "political issue with an economic situation." . . . New West Coast crude prices give 25-cent increase to 20° and above gravity oil. . . . ¶Mid-Continent markets featured by exceptionally strong demand for residual fuel oil. ¶Indiana Standard announces 1/2-cent tank-wagon increase effective March 26. . . . ¶Jersey Standard raises tank-wagon prices of principal products throughout marketing territory. . . .

REFINING— Sidney A. Swensrud, Ohio Standard executive vice president, tells W.P.P.A. in San Antonio that supply and demand conditions for the next few years favor a financially healthy refining industry. . . . M. B. Chittick, Pure Oil Co., says at association meeting, that petroleum refiners have important place in petrochemical industry but that they should investigate carefully before entering. . . . ¶Continental makes only bid for U. S. plant at Ponca City, offering $3,034,040. . . . ¶Frontier offers $1,994,300 for U. S. facilities at Cheyenne. . . . ¶Cooperative Refinery Association buys government plant at Coffeyville, Kans., for $1,200,000. . . . ¶New 3,000-bbl. daily catalytic cracking unit goes on stream at Leonard Refineries, Alma, Mich., plant.

NATURAL GASOLINE—Shell reports $3,000,000 natural gasoline plant in TXL field to be completed by the end of the year. . . . ¶Contract signed for construction of $4,000,000 plant in Rangely field by Stanolind and The California Co. . . . ¶Seeligson operators say plant in that field will be built as soon as materials and labor permit. . . . ¶Sun and C. H. Murphy, Jr., begin construction of $2,500,000 gasoline plant in Delhi field, Louisiana. . . . ¶Skelly reveals in annual report that a new gasoline plant will be built soon in Stephens County, Oklahoma. . . .

PRODUCTION— Texas Railroad Commission makes substantial increase in April allowable order. . . . Order will permit production of 2,374,000 bbl. daily of crude, natural gasoline and distillate. . . . Allowable takes into consideration cut ordered recently in Seeligson field production to curtail waste of gas. . . .

EXPLORATION— Crockett County, Texas, discovery out of control after making strong flow 40°-gravity oil and 15,000,000 cu. ft. gas from Permian at 5,621-70 ft. . . . ¶Refugio County, Texas, discovery 4 miles southwest of Woodsboro flows 155 bbl. pipe-line oil per day. . . . ¶Phillips gets new Ellenburger production in southwestern Cooke County, Texas. . . . ¶San Juan County, New Mexico, test flows 3 bbl. distillate hourly and gas volume 8,000,000 cu. ft. per day from Dakota at 6,450-6,694 ft. . . . ¶Blowout in Standard of California's deep test in Ventura County starts fire and destroys equipment. . . .



The important Canadian discovery, Imperial-Leduc 1, here is being swabbed as a crowd of more than 500 persons waits for the flow of oil and gas to begin. Inset indicates operating conditions during the drilling of the well, when the temperature much of the time was 35° below zero. Completion of the well opened a promising new field southwest of Edmonton. In initial tests the well, bottomed at 5,066 ft., flowed 40 bbl. an hour. Imperial-Leduc 2 is now drilling below 4,000 ft. and Imperial-Leduc 3 is rigging up

International

WORLD-WIDE OIL DEVELOPMENTS

Two Companies Formed to Push Exploration in Australia

AN intensified search for oil and gas on the Australian Continent is slated to be carried out jointly by American, Australian, and British interests.

In making this announcement, P. W. Parker, board chairman of Standard-Vacuum Oil Co. (a subsidiary of Standard Oil Co. [N. J.] and Socony-Vacuum Oil Co., Inc.) said that two new Australian companies are being organized for this purpose. Vacuum Oil Co., Pty., Ltd., a Standard-Vacuum subsidiary which markets throughout Australia, New Zealand and South Pacific islands, will supervise the technical operations of the new exploration companies.

Vacuum will own a one-third interest and the other two-thirds will be equally divided between D'Arcy Exploration Co., Ltd., a subsidiary of Anglo-Iranian Oil Co., Ltd.—the British interest—and Zinc Corp., Ltd., the Australian interest. The latter has extensive mining interests in Australia, including the famous Broken Hill mines in New South Wales with their rich lodes of zinc, silver and lead.

To date, drilling in Australia has not resulted in the discovery of any commercial quantities of petroleum. Vacuum Oil Co. geologists take the view that the geological and geophysical work done by other oil companies in that country, even in areas considered most favorable for oil accumulation, is inconclusive. Therefore the plan to continue the search, using the latest exploratory methods and equipment, has been adopted.

One of the new companies, Parker said, will be known as the Frome-Broken Hill Co., Pty., Ltd., and will start immediately on comprehensive geological and geophysical surveys within an extensive area which includes parts of South Australia, Queensland, and New South Wales. A gravity-meter crew is now on its way to Australia to begin this work. If natural gas should be found in this area, the fuel would find an immediate outlet at the Broken Hill and Port Pirie smelting operations. W. S. Robinson, who is managing director of Zinc Corp., Ltd., and a world authority on base metals, has taken a leading part in urging that the search for oil and gas in Australia be renewed.

The other new company, Bonaparte Gulf Co., Pty., Ltd., will investigate large unexplored areas in Northern Territory and Western Australia. Preliminary aerial and surface geological reconnaissance will be carried out under the direction of Dr. Frank Reeves, who has already arrived at Melbourne from the United States.

Dr. Robert Sauve will coordinate the exploration work of the two new companies. A prominent geophysicist, he has had extensive experience with a subsidiary of Standard-Vacuum in the Netherlands East Indies.

The present exploration program has been developed in close cooperation with the Australian Government through Dr. Harold Raggatt, director of the Commonwealth Mineral Resources Survey. Parker pointed out that the finding of oil in Australia would be of great importance from the standpoint of industrial development as well as that country's national defense.

Foreign Manufacturing Operations "Uncertain," Jennings Says

DESCRIBING the status of manufacturing operations of affiliated companies in foreign countries as "uncertain," B. Brewster Jennings, president of Socony-Vacuum Oil Co., Inc., said in the company's annual report that "this condition probably will continue until the economic and political picture abroad is clarified."

In Poland, Jugoslavia and Czechoslovakia, Socony-Vacuum's affiliates are barred from the management of their refineries, and in Germany, Austria, and Romania, they are greatly restricted, Jennings said.

However, marketing operations were better in 1946 than they had been in 1945, he said, although they continued generally to "reflect the political conditions prevailing in the different countries."

The company's foreign marketing operations in western Europe, extending eastward as far as the American, British and French armies stood when firing ceased, progressed somewhat, as did similar operations in Greece and Turkey. However, in the large area of central and eastern Europe, which remains under Soviet influence, Socony-Vacuum's affiliated companies were prevented from reestablishing normal business.

"Elsewhere in Europe," he added, "the demand for petroleum products is increasing, both in quantity and variety. Plans for rehabilitation and development in France are well under way. In Scandinavia, business has done well although the continued threat of government monopolies creates uncertainty. In England, Holland, Belgium, Switzerland, Spain, Portugal, and Turkey operations during the year compare favorably with prewar. The reestablishment of our affiliates in Italy has been retarded, but now appears to be proceeding satisfactorily. In the Near East, North Africa, and West Africa, business is approaching normal patterns."

Concerning South American oil production, Jennings said gross production from the Barco concession in Colombia (jointly owned with The Texas Co.) continued about as in 1945, with Socony-Vacuum's share being 8,400 bbl. daily.

In eastern Venezuela, the company completed 31 wells in the Guario and Guico areas. Gross production averaged 22,000 bbl. daily, compared with 11,000 bbl. daily in 1945. Currently, production is approximately 26,000 bbl. daily. Up to the present this crude has been shipped to seaboard through pipe lines owned by other companies. But as these lines are unable to handle Socony-Vacuum's increased production, a 12-in. line is being built to move crude to the coast.

California Texas Oil, Ltd., Acquires Texaco European Outlets

MARKETING outlets in 17 Eastern Hemisphere countries were recently acquired by California Texas Oil Co., Ltd., from The Texas Co. Caltex has marketed east of Suez since 1936. Acquisition of the properties gives the company wide distribution throughout the greater part of the Eastern Hemisphere.

With the exception of certain marine equipment, the Ethyl companies, and a French company which owns real estate in French possessions overseas, Caltex has acquired all Texaco interests and facilities in Europe and the Mediterranean area, including such countries as the following:

Norway, Sweden, Finland, Denmark, Iceland, Great Britain, Eire, Germany, Netherlands, Belgium, Luxemburg, France, Switzerland, Italy, Poland, Hungary, Yugoslavia, Austria, Czechoslovakia, Rumania, Bulgaria, Turkey, Greece, Albania, Spain, Portugal, Madeira, Spanish Morocco, Algeria, Tunisia, Libya, Syria, Iraq, and Iran.

The principal marketing areas involved are those in England, Sweden, France, Belgium, Netherlands, Denmark, and Norway. Facilities acquired by Caltex include a chain of terminals, bulk plants, canal and overland transportation units, service stations and regional offices.

Caltex has also obtained a going organization which has grown over the course of many years of operation. One of the most important of the acquisitions in Europe is that of an experienced qualified personnel. There has been strong emphasis on employment and advancement of the nationals of the countries, so that today these European staffs consist principally of citizens of the nations in which they operate.

In addition to marketing facilities in Europe, Caltex has acquired Texaco's interest in the Societe des Raffineries de Petrole de la Gironde, which before the war operated a refinery at Ambes, France, near the mouth of the Gironde River, near Bordeaux. The refinery had a daily capacity of about 7,500 bbl., and the products were distributed principally in southern and western France. The plant suffered war damages, but plans are in progress for its rehabilitation.

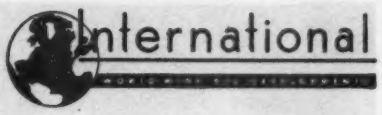
The major percentages of the products marketed by Caltex are refined at Ras Tanura and Bahrein Island, in the Persian Gulf, from crude produced by the Arabian American Oil Co. and the Bahrein Petroleum Co., Ltd., both jointly owned by California Standard and Texaco. Lubricants and special products are shipped from the United States.

The European subsidiaries were sold for approximately $28,000,000, of which $7,500,000 was paid in cash and the balance covered by notes of Caltex payable over 10 years. The sale did not include the Norwegian tanker fleet.

I.S.A.P.'s Lima Meeting Indefinitely Postponed

The first international general meeting of the South American Petroleum Institute, scheduled to be held May 12-17 in Lima, Peru, has been indefinitely postponed.

Herman E. Villar, general secretary of I.S.A.P. at Montevideo, Uruguay, and Roberto L. Valverde, secretary general in charge of arrangements in Lima, made simultaneous announcements of the postponement for unavoidable reasons. Valverde said a representative of the institute would visit each country and explain the postponement. Another date for the meeting will be set later, he said.



Creole Repressuring Plant Near Completion

The crude-stabilization and repressuring plant being built by Creole Petroleum Corp. at Jusepin in Eastern Venezuela is nearing completion.

Plans are on the boards for a plant for the same purposes in the nearby Mulata area. A plant at Oficina, which is a joint venture of Creole and Mene Grande Oil Co., will be in operation soon. Creole is studying the situation in San Joaquin field to determine whether it will be economical to build a stabilization and repressuring plant there.

Russia Makes Another Token Austrian Payment

Obviously in no rush to compensate United States and British oil companies for crude and products taken from foreign subsidiaries of these companies in Austria, Russia, nevertheless, has just made another token payment, this time 7,000,000 schillings (about $700,000). Last month, the Soviet paid the companies 5,000,000 schillings (about $500,000).

With the latest payment, Russia, according to a dispatch from Vienna, proposed a long-term understanding indicative of the fact that she intends to remain in the oil business in Austria.

Foreign visitors at the March meeting of the Houston Nomads were: L. R. Leard, Socony-Vacuum Oil Co., Inc., Cucuta, Colombia; R. N. Posgate, Venezuelan Oil Concessions, Ltd. (Shell), Maracaibo, Venezuela, S. A.; D. D. Lewis, Calgary, Alberta, Canada. Speaker for the meeting was Jerry Rice, vice president of Tennessee Gas & Transmission Co.

Saudi Arabia has taken a place as one of the world's major oil-producing areas in recent years. This aerial view shows the town of Dhahran, erected by Arabian American Oil Co. adjoining the discovery field of Dammam

Foreign Oil Production Reviewed In 16 A.I.M.E. Papers

by Warren W. Burns

WITH interest centering on the Middle and Far East, 16 papers reviewing foreign oil production were presented last week in New York before the petroleum division at the seventy-fifth anniversary celebration of the American Institute of Mining and Metallurgical Engineers.

Several of the papers, particularly those on India, Burma, Hungary, Romania and Italy, were replete with information heretofore bottlenecked by wartime censorship, Russian barriers (as with Romania and Hungary), or mere unavailability.

Reviewing countries of the Middle East, according to their percentage of crude output in that area, the field data on Iran, supplied by Anglo-Iranian Oil Co., Ltd., and presented by Norval E. Baker, chief geologist for Iraq Petroleum Co., Ltd., showed that no new wells were drilled in 1946. Production was controlled with the recycling of surplus products having been maintained with existing wells.

In Iran's White Oil Springs field, production is to be developed to augment the output from Haft Kel, largest field in Iran and second largest in the world. At Agha Jari, drilling to date has proved productive conditions over an area some 12 miles long by 3 miles wide. The area so far proved is in course of development and additional pipe-line facilities, in the form of 12-in. pipe lines, are being constructed.

International

A second report on the foreign-oil production papers presented at the New York A.I.M.E. meeting will appear in The Oil and Gas Journal, April 5.

At Naft-i-Shah, production continued to supply local markets in northwestern Iran. The policy of recycling surplus products to the reservoir has been continued. At Lali, exploratory drilling, before the war, had discovered a structure 25 miles northeast of Masjid-i-Sulaiman, and although the presence of oil was proved, the formation was so tight that commercial production was not obtained. However, during 1946, the discovery well was deepened and after acid treatment yielded evidence of commercial possibilities. Further drilling is now in progress.

Iran's net production by fields for the past 2 years follows: (All figures in long tons. A long ton is approximately 7.7 bbl.)

Fields—	1945	1946*
Masjid-i-Sulaiman	2,671,268	3,674,000
Haft Kel	9,476,464	8,731,000
White Oil Springs	333,478	696,000
Agha Jari	2,339,198	4,056,000
Pazanun	31,732	27,000
Gach Saran	1,905,347	1,874,000
Naft-i-Shah‡	82,003	93,000
Total	16,839,490	†19,151,000

*Actual to end of September; estimated for October, November, and December. †To nearest 1,000 tons in each field. ‡Net production; i.e., exclusive of recycled products.

The total amount of sulfur produced during 1946 at Iran's sulfur-recovery plants, two of which are located in Masjid-i-Sulaiman and a third at Abadan, was approximately 11,700 tons, December's production having been estimated.

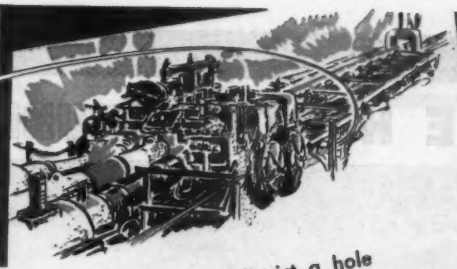
Considerable progress has been made in the general postwar rehabilitation program. The deterioration of property has been made good, and many of the wells mudded off as a wartime emergency have been reclaimed and put back into use.

James Terry Duce, vice president of Arabian American Oil Co., stated that Saudi Arabian production in 1946 of approximately 165,315 bbl. daily showed 94,753 bbl. daily from Dammam; 67,900 bbl. daily from Abqaiq; and 2,662 bbl. daily from Qatif.

Five wells were completed in Dammam field and four wells in Abqaiq field. Five locations were rigging up at Abqaiq and one at North Abqaiq. The Abqaiq 10 well brought in at 7,420 ft. established an oil column for the field approximately 1,500 ft. high. It completely penetrated the producing zone and found no water. Therefore, Duce said, the extent of the field is not known. Edge water has not yet been found.

In Iraq, Chief Geologist Baker said that extensive geological and geophysical surveys were carried out during 1946, particularly in southern Iraq where seismic, gravity, and magnetic crews have been at work. In

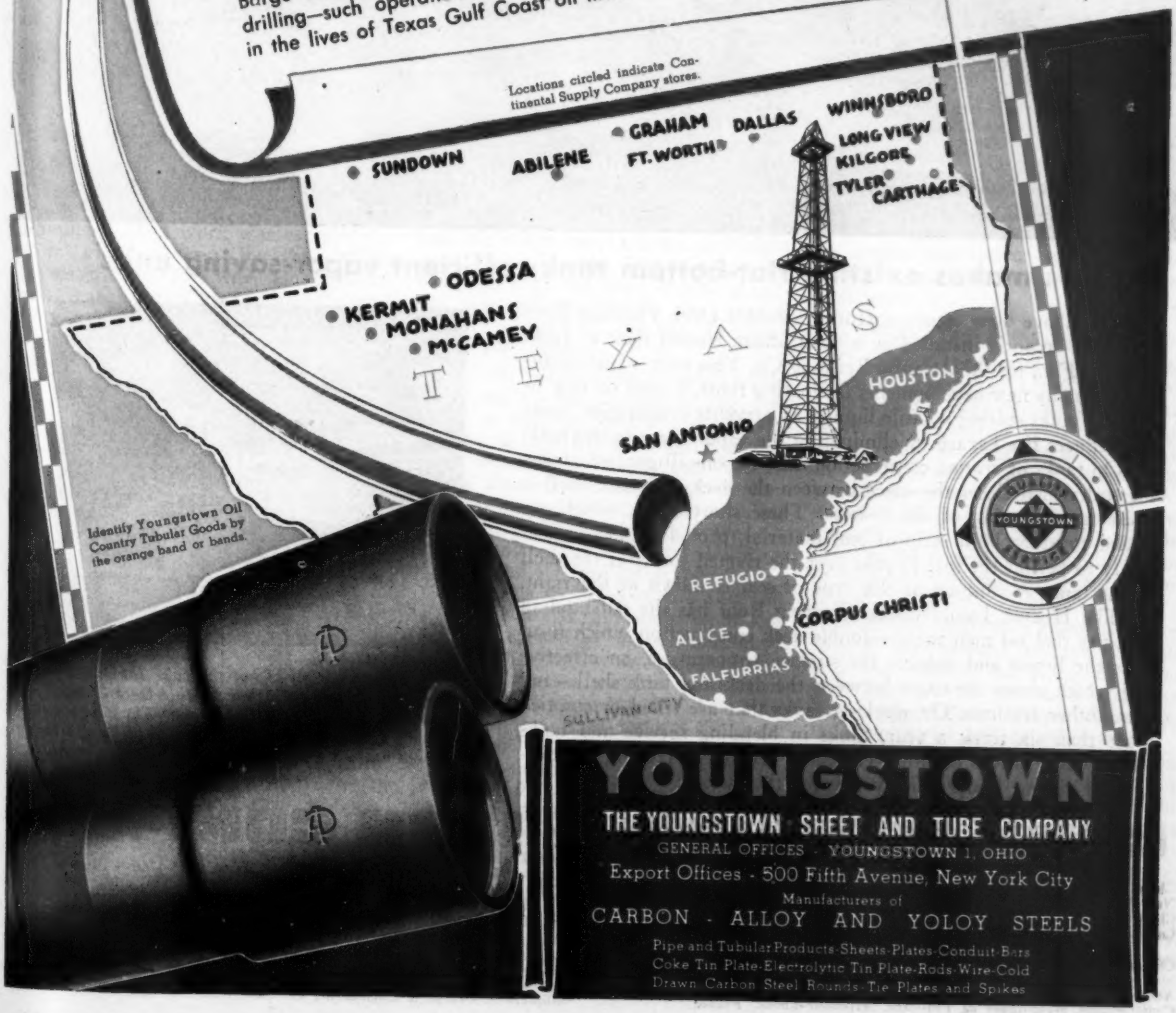
Youngstown to the TEXAS GULF COAST



No region of North America is richer in oil than the Gulf Coast of Texas. There in a broad belt stretching from the Sabine to the Rio Grande, out in the waters of the Gulf itself and over a hundred miles inland, oil men produce nearly a fifth of the country's crude. There, too, is stored an even larger portion of the nation's proven reserves.

To produce this oil calls for unusual ingenuity, hard work, perseverance and high grade equipment in overcoming almost every difficult condition known to oil men. Barge drilling, deep drilling, high pressure drilling—such operations are commonplace in the lives of Texas Gulf Coast oil men. In 1945 in the Upper Coastal district a hole was drilled at 815 feet more than three miles down—one of the world's deepest wells.

When the pioneers struck oil at Spindletop in 1901, Youngstown was just a year old. Throughout the oil history of this great region, Youngstown has supplied a large share of the oil country's tubular goods. Operators in the several districts comprising this coastal area have found that Youngstown drill pipe, casing, tubing and line pipe is suitable for their toughest drilling, production and transportation requirements. Here, as in every other field, the orange bands on pipe are recognized as the sign of quality and dependability.



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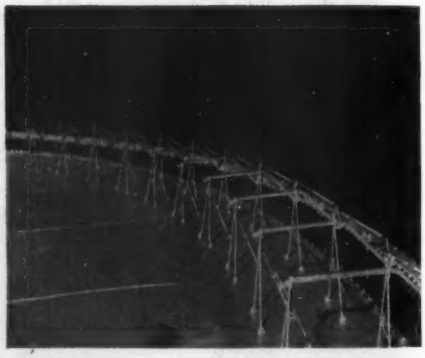
THE HORTON DOUBLE-DECK FLOATING ROOF

. . . makes existing flat-bottom tanks efficient vapor-saving units

The above view shows a Horton Double-Deck Floating Roof which we recently installed on a 65-ft. diam. riveted tank at Jacksonville, Fla., for the Atlantic Refining Co. This roof, which incorporates many new developments in floating roofs, is used on new or existing tanks storing volatile liquids. It prevents evaporation losses and reduces fire hazard by eliminating the vapor space in the tank.

On tanks of riveted construction, like the one illustrated above, the seal which closes the space between the deck and tank shell is made up of a ring of short shoes. These short shoes, which are joined together by a strip of seal material, provides enough flexibility to permit the seal to pass over the riveted joints in the shell of the tank. A close-up of this type of seal is shown at the right.

The Horton Double-Deck Floating Roof has the outstanding qualities that oil men want—double-deck construction which insulates the liquid and reduces the surface temperature, an effective seal which closes the space between the deck and tank shell—and many other features. On working tanks that are filled or emptied more than six times a year, tanks in blending service and tanks storing sour crudes or other corrosive products—Horton Double-Deck Floating Roofs quickly pay for themselves.



The illustration at the top of the page shows a view across the top of a Horton Double-Deck Floating Roof on a 65-ft. diam. riveted tank. The photo immediately above shows the construction of the Horton seal used on tanks with riveted shells or lap-welded shells.

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Los Angeles, 14.....1423 Wm. Fox Bldg.
Atlanta, 3.....2154 Healey Bldg.
Birmingham, 1.....1536 North 50th St.
Tulsa, 3.....1606 Hunt Bldg.
Houston, 1.....5619 Clinton Dr.
Philadelphia, 3.....1615-1700 Walnut St. Bldg.
Havana.....402 Abreu Bldg.
San Francisco, 11.....1254-22 Battery St. Bldg.
Detroit, 26.....1514 Lafayette Bldg.

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Leopoldo Sol & Cia., Reconquista 558, Buenos Aires, Argentina
Horton Steel Works, Limited, Fort Erie, Ontario, Canada
Whessoe, Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland

northern Iraq, regional stratigraphic studies of that part of the Persian Gulf geological province are currently under way.

A total of 12,346 ft. were drilled in seven wells, four of which were completed and three continued drilling. Average depth of Iraq's completed wells was 3,070 ft. There was development west of the Tigris area, Baker said. About 88,000 bbl. daily was pumped through the Kirkuk-Mediterranean pipe lines.

As of January 1, last year, Iraq had 14 producers, 3 oil and water observation wells, 1 oil and gas observation well and 3 were drilling. As of December 31, there were 17 producers, 4 oil and water observation wells, 1 oil and gas observation well and 3 drilling.

On Bahrein Island, six wells were drilled in 1946, Duce said, with the refining operations continuing at a high rate. The Awali plant on Bahrein has been running at approximately 105,000 bbl. daily. Saudi Arabian crude was delivered to this plant through the pipe line which crosses the Gulf of Selwa. Bahrein's single field produced about 21,000 bbl. daily.

Egyptian Exploration

The A.I.M.E. paper on Egypt was prepared by El-Hanafi El-Sayed Fahmy, assistant director general of Egypt's Department of Mines. By the end of 1946, Fahmy said, there were 12 geological parties in the field with a limited paleontological staff. The study of microfauna received special attention by all operating companies. Photogeological work was carried out from photos taken by the Allied forces during the war. Geophysical work consisted of limited gravity surveys, filling spots left and linking or elaborating on the various reconnaissance surveys already completed before the war.

During 1946, seven rotary rigs were running on wildcats, and operations were maintained on 16 wells. Four of these wells were spudded in 1945 and completed as dry holes in 1946. Six of the wells were spudded and completed in 1946, five of which were dry holes and the sixth, the Sudr discovery well was a producer from the basal Miocene in the Gulf of Suez area.

During 1946, Egypt saw a total well footage drilled of 70,649 ft., including operations which were still in progress at the close of the year. These six wells and their depths were: Abu Rauwash 2—3,301 ft., Abu Rudeis 1—6,722 ft.; Khabra 1—10,052 ft.; Nebwi 1—4,436 ft.; Sudr 2—5,908 ft.; and Ataqa 1—1,577 ft.

Egyptian production came largely from Ras Gharib field where the daily average output was 23,055 bbl. with Hurghada, the next largest field, producing about 879 bbl. daily. Total daily Egyptian output last year approximated 25,100 bbl. daily.

Six wells were completed in Ras Gharib, all producers with no wells abandoned. By the end of 1946, there were 81 wells in this field actually on production with 14 more producers shut in for technical reasons, apart from a few wells which were awaiting repairs. In Hurghada, no new production was obtained and six wells were abandoned on reaching their economic limit, thus making the number of remaining producers here 56, while three wells were awaiting repairs or abandonment.

The total area in Egypt under petroleum exploration permits, at the close of 1946, totaled 17,800,000 acres. Under petroleum prospecting licenses there were 445,000 acres and under petroleum mining leases there were 26,700 acres.

Burma-India Fields

Particular interest was evidenced on the Burma-India papers, largely due to the fact that extremely little information has been available about these areas since before the war. These papers were prepared under the direction of P. Evans, chief geologist of Burmah Oil Co., Ltd.

Geographically, the main Burma oil fields lie near the Irrawaddy, about 300 miles from Rangoon. From south to north, they are: Minbu (a group of small fields on west bank of the Irrawaddy); Yenangyuang Singu or Chauk, Lanywa (notable for its inclined wells beneath the river), and Yenangyat.

For many years Yenangyaung field had been the most important, but in 1938 the Singu (now known as Chauk) field came into the lead. During the early part of the war, Burma's output was slightly above the prewar level of about 7,500,000 bbl., or about 20,300 bbl. daily.

In 1946, rehabilitation was greatly hampered by the absence of law and order in country districts of Burma and by delays in the supply of oilfield equipment from the United States. Demolished derricks, wrecked workshops, and other damaged buildings were cleared. Roads were repaired and other essential building went ahead as rapidly as possible.

It remains to be seen, the Burmah Oil Co. geologist said, as to what loss has been caused by the dissipation of gas and the inflow of water. However, it is certain that the production from Burma's main fields will be considerably less than before the war. At present, production of Assam Oil Co., Ltd., a subsidiary of Burmah Oil, is about 6,000 bbl. daily.

To handle this small production, an entirely new refinery has had to be planned and its errection will start as soon as the material can be assembled near Rangoon.

In India, the only oil fields before the war were at Digboi in Assam, and Khaur and Dhulian in the Punjab Province of northern India. Digboi's annual output was about 1,950,000 bbl., or 5,342 bbl. daily. The discovery of Dhulian brought the Punjab output up from about 300 bbl. daily to around 2,191 bbl. daily just before the war.

During the early part of the war, Punjab production reached 2,465 bbl. daily, but later showed a considerable decline. When the Burma fields were lost, the small indigeous Indian production acquired greater importance and Digboi field, situated on what was to become the supply line to Burma and China, was able, by stepping up its production, to make a vital contribution to military requirements for petroleum products, and correspondingly reducing the pressure on the limited transport facilities of northeastern India.

A notable achievement in India was the construction of hundreds of miles of pipe line, much of it, near the India-Burma frontier, through the most difficult country imaginable. The first pipe line to be constructed was laid by Burmah Shell Oil Co., Ltd., and the latter more extensive lines by the U. S. Army.

The wartime restriction on exploration was accomplished by a moratorium on concessionary obligations, Burmah Oil's Egans pointed out. This restriction was continued in 1946 since it was impossible for the companies to obtain equipment and personnel to carry on with the war-suspended programs.

Work Now Being Resumed

Currently, preparations are being pushed forward as rapidly as possible, both for drilling and geophysical work. By the end of 1946, two seismic crews were making plans to operate in northwestern India. Geophysical parties were working in western and eastern India. A small amount of gravity work was done during the war in the immediate neighborhood of Digboi field, and this is being continued.

Moreover, drilling is going ahead on several concessions in the Punjab, and the Attock Oil Co.'s Balkassar well has proved oil in a structure near Joya Mair. Preparations are being made to drill in other areas.

Production in India last year is estimated at approximately 6,000 bbl. daily, compared with about 7,100 bbl. daily in 1945, the drop being partly due to the return to normal in Digboi and partly because of the decline at Dhulian. The newly-discovered fields in the Punjab have made only a small contribution to India's total output, and this is partly due to the fact that the country has not yet started normal postwar production.

Southwest A.P.I. Production Meeting Opens in Fort Worth

by George Weber

FORT WORTH.—The first of this year's district spring meetings of the American Petroleum Institute's Division of Production opened in Fort Worth March 27. A record attendance for the 2-day southwest district meeting, probably exceeding 700, was indicated.

W. E. HAWKINS

The morning of the opening day progress was reported on the Institute's program covering vocational training, production practices, drilling practices and drilling fluids, materials, production technology, secondary-recovery methods, core analysis and well logging, and allocation of production and well spacing.

At the first general session in the afternoon a clear, candid discussion of the Federal Power Commission's assumption of jurisdiction over the natural-gas industry was presented by Walace Hawkins, vice president and general counsel, Magnolia Petroleum Co. "The year 1946 revealed the legal subtleties and devices employed by the commission in its calculated program to secure control of the natural-gas producing and gathering business and natural-gas producing properties," he said. "The undisclosed pattern was a simple one. Having freed itself from effective judicial review, the commission exploited, both horizontally and vertically, its restricted and limited powers. Its granted power and jurisdiction over transportation of gas in interstate commerce and sales for resale after transportation were enlarged and extended, while its prohibited jurisdiction with respect to production and gathering was narrowed and restricted."

Citing the spread of the commission's jurisdiction he continued, "The exercise of such claimed jurisdiction meant nothing more or less than national control and regulation of the oil and gas industry. . . . Unless, therefore, the asserted powers and jurisdiction of the Federal Power Commission are restricted and limited as was originally intended by Congress, we have the accomplished fact of federal control. And more than that, we have control of the oil and gas industry by a national bureau whose power is limited to the regulation of interstate transmission of gas and sale thereof after such transportation."

Discussing the recently released report of the commission's staff he stated, "The recommendations and suggestions of the staff fail miserably to restore the Natural Gas Act to its original scope and purpose. The suggestions of the staff report apply only to minutia. It fails to reach the substance and merits of the matter at hand. . . ."

The only remedy to this situation, Hawkins asserted, is congressional action, amending the Natural Gas Act. "The act can now be restored to its original proportions and purposes only by the authority that created it—the Congress of the United States. Should the commission disclaim its exaggerated ideas of power and jurisdiction and should it abandon its notion that this special legislation is the breeding ground for countless implied powers, its emaciated form would nevertheless always harbor dire threats to the oil and gas industry."

Public-Relations Program Report

A progress report on the industry's public-relations program was presented by Ralph C. Champlin, director of public relations, Ethyl Corp. In reviewing the need for an industry-wide program, he cited the conviction of many that the fate of the oil industry as a free competitive system of business depends on our success in achieving that understanding on the public's part.

Outlining steps to be taken, Champlin stated, "We have resisted the temptation to rush into print with the arguments in favor of the oil industry that might be produced by a small committee and broadcast to the public. The first step in our program is to achieve an understanding of the importance of the job and the means of doing it in the minds of leaders in the industry."

Friday's sessions were to be devoted entirely to technical subjects, dealing principally with drilling, well completion, and secondary-recovery methods. (Two technical papers, "Hard-Rock Drilling in the Permian Basin," by David Johnson, Humble Oil & Refining Co., Midland, and "Packer Problems in West Texas," by T. H. Dwyer, Shell Oil Co., Inc., Midland, will appear in The Oil and Gas Journal April 5. Other technical papers given at the meeting are scheduled for later publication).

Green Elected S.E.G. President

LOS ANGELES.—Cecil H. Green, of Geophysical Service, Inc., Dallas, was elected president of the Society of Exploration Geophysicists here Monday night. Other officers elected were: vice president, L. L. Nettleton, of Gravity Meter Exploration Co., Houston; secretary-treasurer, Thomas A. Manhart, Seismograph Service Corp., Tulsa, and editor, M. King Hubbert, Shell Oil Co, Inc., Houston.

The election was held during a joint meeting of the American Association of Petroleum Geologists, the Society of Exploration Geophysicists, and the Society of Economic Paleontologists and Mineralogists.

Production Division Sets Company Safety Record

A safety record of a year's operation without a single disabling injury was set during 1946 by East Texas division employes of the production department of Shell Oil Co., Inc. It was the first time in the history of the Texas-Gulf area that employes of an entire division had completed an accident-free year.

By January 1 the division's employes had completed 407 consecutive days, involving 638,172 man hours, without a disabling accident. The division's work includes drilling, producing and servicing of about 1,200 wells.

Texas Commission Orders Hearings on Gas Waste

In another move to halt gas waste, the Texas Railroad Commission this week ordered operators of 15 fields to appear and show cause why their wells should not be shut in until flare gas is utilized.

The commission's stern policy toward gas flaring was made apparent a week ago when it ordered Seeligson field shut in April 1 to force gas conservation. Operators of the 15 fields were ordered to appear at five hearings. Hearing dates and fields follow:

April 8—Heyser, Tom O'Connor, and West Ranch; April 9—Anahuac, Conroe, North Withers, Magnet Withers, and Webster; April 10—Agua Dulce; April 11—North Cowden, Goldsmith, McElroy, Slaughter, and Wasson; and April 15—KMA.

WASHINGTON WATCHING

BY HENRY D. RALPH

Tank-Car Reshuffle

WASHINGTON. — The "off again, on again, gone again" story of the Government's liquefied-petroleum-gas tank cars was unfolded in documented detail last week before the House committee on expenditures in the executive departments in the course of its investigation of surplus selling by War Assets Administration.

Ever since last spring L.P.G. shippers have been actively trying to buy government-owned pressure type tank cars leased to them during the war when priorities prevented them from obtaining their own. All during this time the Government has been changing its policy on disposal, alternately proposing to cancel the leases, turn the cars over to the Army's fertilizer program, sell them to present lessees, or place them on the open market for any one to buy.

Chief complaining witnesses were Martin H. Champion, of Pioneer Equipment Co., Oklahoma City, a war veteran who tried unsuccessfully to purchase 66 cars under veteran's preference rights, and R. J. Jopling, vice president of Phillips Petroleum Co., who complained that under the most recent disposal plan his concern can obtain only 24 of the 189 cars it now operates on lease.

To date the investigation has uncovered nothing scandalous and little new—just the not unique story of indecision, fluctuating policy, interdepartmental disagreements, and bungling bureaucracy.

ODT drew up a schedule offering certain numbers of cars to each L.P.G. shipper or his designated agent. All the L.P.G. companies accepted the sales offer, but many of them assigned their rights to tank-car leasing companies as their agents. This was O.K. until WAA discovered that Union Tank Car Co. would thus get a total of 204 of the cars, valued at more than $1,000,000, so under the "monopoly" provision of the surplus-property law this transaction must be approved by the Department of Justice.

Now veterans claim they are denied their priority purchase rights. Chemical and fertilizer companies would like to get hold of some of these cars. L.P.G. shippers insist their customers will suffer great hardship if they lose the cars. ODT agrees with the L.P.G. industry but claims its allocation schedule is fair. Phillips complains the ODT plan won't help the industry over-all but simply reshuffles the business among its competitors.

The committee appeared to be not satisfied that the latest disposal plan meets the requirements of the Surplus Property Act or the needs of the L.P.G. industry, and proposed to make a recommendation to WAA before the end of this week.

NPC's New Secretary

THE National Petroleum Council will be represented in Washington by a veteran of the oil industry, of trade association work, and of government operations.

Chairman Walter S. Hallanan has announced the appointment of James V. Brown as the council's secretary-treasurer. For the past 5 years Brown has been analyst on the Washington staff of the Independent Petroleum Association of America, and ever since the NPC was set up he has been keeping the council's records as unofficial deputy to "temporary secretary" Russell B. Brown (no relation), general counsel of I.P.A.A.

Jim Brown got his first government and oil experience as an accountant in the Bureau of Internal Revenue, assigned to oil tax matters in the Bradford, Pa., district office back in the '20's. He then ran his own public-accounting and tax-consulting business in Bradford and acquired interests in oil production. He still has an interest in the Healey Pertoleum Corp. of Bradford.

Lease-Option Controversy

THE 100,000-acre limitation on options for leases on public lands should not include options on pending applications for new leases, in the opinion of spokesmen for the oil and gas industry who are vigorously protesting a decision of Oscar L. Chapman, under secretary of the interior.

The decision was included in recent letters to F. W. Gower, chairman of the public-lands committee of the Rocky Mountain Oil and Gas Association. Except for this one provision, the changes meet virtually all the objections to the regulations which were raised by industry committees.

The new law permits an oil or gas operator to obtain from lessees of public lands 2-year, nonrenewable options to purchase leases, up to a limit of 100,000 acres per operator in any one state. During this period the operator may conduct prospecting, but not drilling activities, and may then exercise his option to acquire leases up to the legal maximum of 15,360 acres.

The department has ruled that this 100,000-acre limitation includes not only options on leases already issued but also options on application for new leases pending in the Bureau of Land Management. The industry contends that applications for leases should not come within the limitation but an operator should be permitted to option them without limit, due to the fact that there is no assurance that the department will issue such leases. After an application is granted, however, the industry admits that the lease should come within the limitation and that the operator's option holdings should be reduced accordingly if necessary to keep with-ing the 100,000-acre limitation.

Sen. E. V. Robertson of Wyoming has protested to Chapman, declaring that the ruling will jeopardize and retard the development of new oil and gas fields on the public domain. As one who assisted in drafting the new legislation, the senator pointed out that its title states its purpose to develop the public domain and that therefore all doubt as to the intent of the law should be resolved in favor of greater development. Several industry associations also have protested.

How to Sell a Ship

OIL tankers can now be bought out of a mail-order catalog just like bicycles.

A recent issue of "Marine Surplus Seller," an illustrated monthly catalog of the Maritime Commission, lists a dozen or more types of war-built vessels for sale "as is, where is" to the first comer, including tankers, tugs, yachts, PT boats, and landing craft. Being classed as "small vessels," they do not come under the complicated provisions of the Ship Sales Act and are offered for spot sale. All you have to do is send in a check for 25 per cent of the catalog price and promise to pay the rest in 30 days, and you can sail off in your ship.

Here's a sample: "Ideal small tankers—all steel—diesel—Army design—built to do a big job—$100,000."

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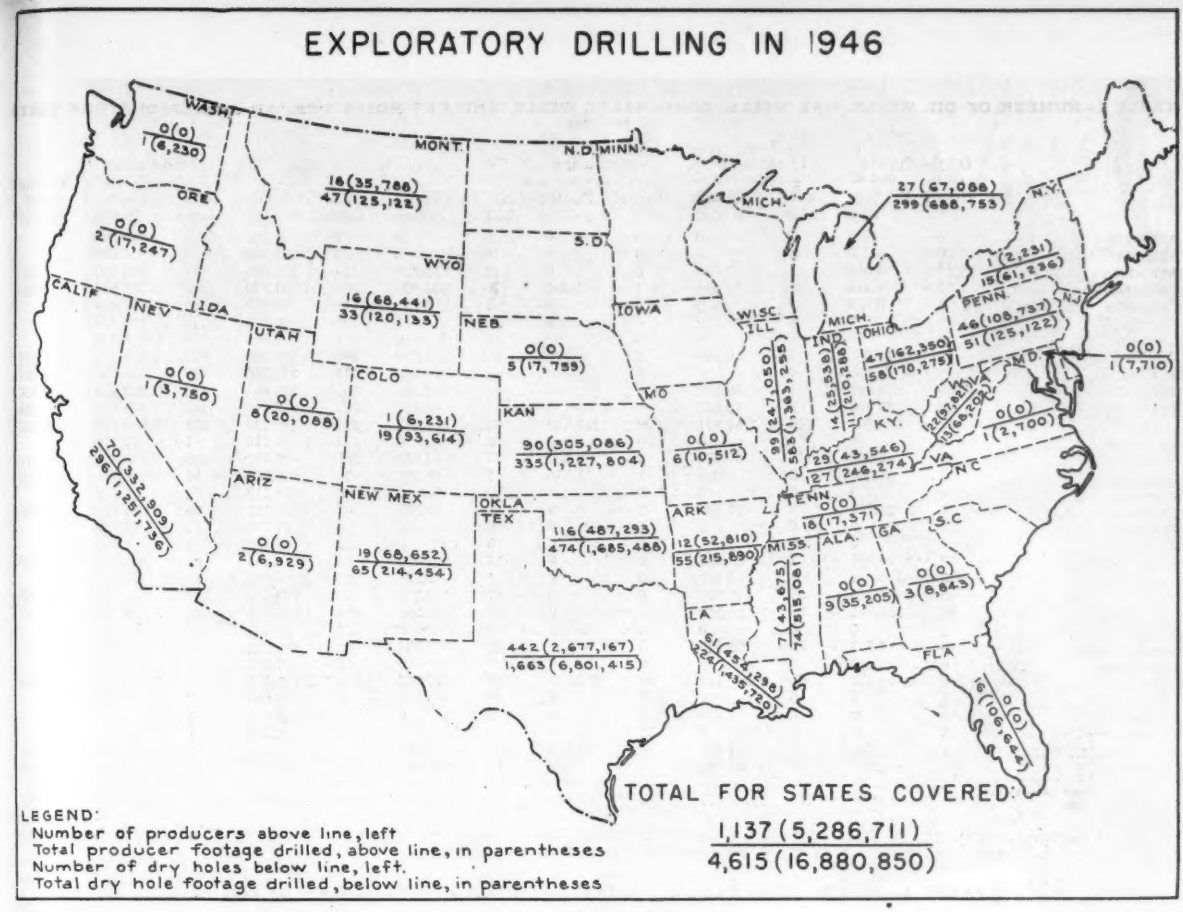

Fig. 1

WILDCAT DRILLING IN 1946

by Frederic H. Lahee

IN the states covered in this review, as shown in Fig. 1, and listed in Table 1, during 1946 a total of 22,167,561 ft. was drilled in 5,752 exploratory holes, divided as follows:

	Feet
1,137 producers	5,286,711
4,615 dry holes	16,880,850

This means that 19.8 per cent of the holes drilled, and 23.8 per cent of the footage drilled, were successful in 1946. One producer foot was drilled for every 3.19 ft. of dry hole. One successful well was drilled for every 4.06 dry holes. The average depth of hole was 3,854 ft.

In the southern states district (Fig. 2), in 1946, a total of 12,580,476 ft. was drilled in 2,635 holes, divided as follows:

	Feet
538 producers	3,276,458
2,097 dry holes	9,304,018

In this area, then, 20.4 per cent of the holes drilled, and 26.0 per cent of the footage drilled, were successful. One producer foot was drilled for every 2.84 ft. of dry hole. One successful well was drilled for every 3.89

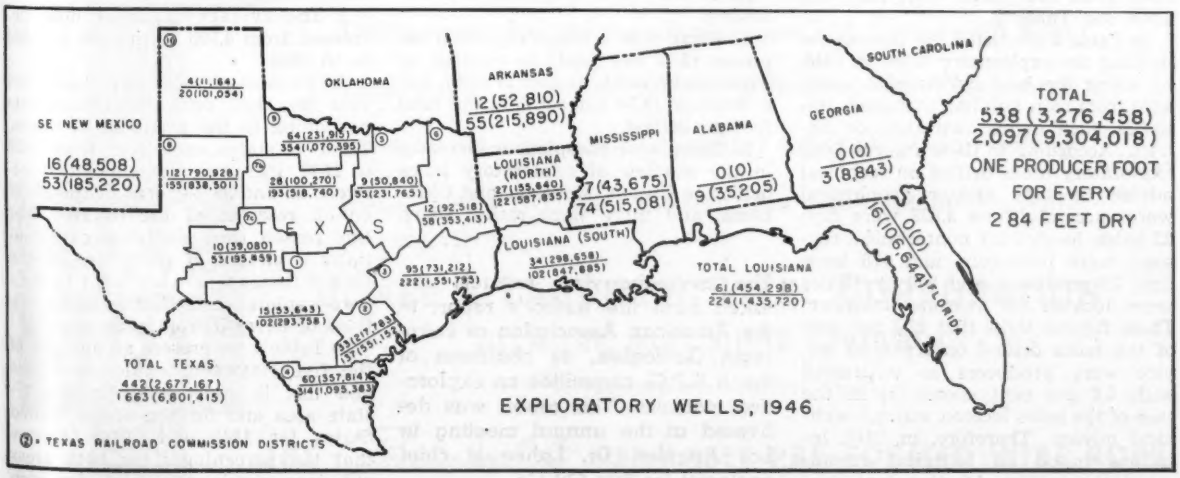

Fig. 2

TABLE 1—NUMBER OF OIL WELLS, GAS WELLS, CONDENSATE WELLS, AND DRY HOLES DRILLED AS EXPLORATORY TESTS IN 1946

States*—	Oil producers		Gas Producers		Condensate producers		Total producers		Dry		Grand total		Average depth of hole†
	No. of holes	Footage drilled	No. of holes	Footage drilled	No. of holes	Footage drilled	No. of holes	Footage drilled	No. of holes	Footage drilled	No. of holes	Footage drilled	
Alabama	0	0	0	0	0	0	0	0	9	35,205	9	35,205	....
Arizona	0	0	0	0	0	0	0	0	2	6,929	2	6,929	....
Arkansas	11	49,295	1	3,515	0	0	12	52,810	55	215,890	67	268,700	4,010
California	55	278,215	14	53,494	1	1,200	70	332,909	296	1,251,736	366	1,584,645	4,329
Colorado	1	6,231	0	0	0	0	1	6,231	19	93,614	20	99,845	....
Florida	0	0	0	0	0	0	0	0	16	106,644	16	106,644	....
Georgia	0	0	0	0	0	0	0	0	3	8,843	3	8,843	....
Illinois	96	244,761	3	2,289	0	0	99	247,050	583	1,363,255	682	1,610,305	2,361
Indiana	14	25,538	0	0	0	0	14	25,538	111	210,288	125	235,826	1,887
Kansas	59	204,775	31	100,311	0	0	90	305,086	335	1,227,804	425	1,532,890	3,607
Kentucky	20	30,443	9	13,103	0	0	29	43,546	127	246,274	156	289,820	1,858
Louisiana	21	134,094	10	67,451	30	252,753	61	454,298	224	1,435,720	285	1,890,018	6,632
Maryland	0	0	0	0	0	0	0	0	1	7,710	1	7,710	....
Michigan	16	41,309	10	20,472	1	5,307	27	67,088	299	688,753	326	755,841	2,319
Mississippi	4	37,367	2	4,938	1	1,370	7	43,675	74	515,081	81	558,756	6,898
Missouri	0	0	0	0	0	0	0	0	6	10,512	6	10,512	....
Montana	12	21,749	6	14,039	0	0	18	35,788	47	125,122	65	160,910	2,476
Nebraska	0	0	0	0	0	0	0	0	5	17,759	5	17,759	....
Nevada	0	0	0	0	0	0	0	0	1	3,750	1	3,750	....
New Mexico	12	35,960	7	32,692	0	0	19	68,652	65	214,454	84	283,106	3,370
New York	0	0	1	2,231	0	0	1	2,231	15	61,236	16	63,467	....
Ohio	8	32,355	39	129,995	0	0	47	162,350	58	170,275	105	332,625	3,168
Oklahoma	91	395,791	25	91,502	0	0	116	487,293	474	1,685,488	590	2,172,781	3,683
Oregon	0	0	0	0	0	0	0	0	2	17,247	2	17,247	....
Pennsylvania	10	17,798	36	90,939	0	0	46	108,737	51	125,122	97	233,859	2,411
Tennessee	0	0	0	0	0	0	0	0	18	17,371	18	17,371	....
Texas	318	1,854,278	68	365,176	56	457,713	442	2,677,167	1,663	6,801,415	2,105	9,478,582	4,503
Utah	0	0	0	0	0	0	0	0	8	20,088	8	20,088	....
Virginia	0	0	0	0	0	0	0	0	1	2,700	1	2,700	....
Washington	0	0	0	0	0	0	0	0	1	6,230	1	6,230	....
West Virginia	2	3,446	6	24,230	14	70,145	22	97,821	13	68,202	35	166,023	4,744
Wyoming	12	41,541	4	26,900	0	0	16	68,441	33	120,133	49	188,574	3,848
Total	762	3,454,946	272	1,043,277	103	788,488	1,137	5,286,711	4,615	16,880,850	5,752	22,167,561	3,854

*No exploratory drilling was reported in Iowa, North Carolina, North Dakota, South Carolina, or South Dakota. †Averages have been recorded here only for states where more than 25 exploratory holes were drilled in 1946.

TABLE 2—COMPARATIVE STATISTICS FOR SOUTHERN STATES, SHOWN IN FIG. 2*

Year	Producers drilled				Dry holes drilled				Total No. explor. holes drilled	Total feet drilled	Average depth of hole (ft.)	Number of dry-hole ft. drilled for each producer ft.
	Holes		Footage		Holes		Footage					
	No.	Per cent	Feet	Per cent	No.	Per cent	Feet	Per cent				
1938	200	13.6	984,262	17.4	1,271	86.4	4,667,402	82.6	1,471	5,651,664	3,842	4.74
1939	161	12.6	779,345	14.8	1,113	87.4	4,501,669	85.2	1,274	5,281,014	4,145	5.90
1940	187	12.8	919,506	†14.9	1,279	87.2	†5,251,273	†85.1	1,466	6,170,779	†4,209	†5.71
1941	258	16.5	1,264,774	18.4	1,305	83.5	5,578,975	81.6	1,563	6,843,749	4,372	4.41
1942	231	16.3	1,289,480	19.6	1,186	83.7	5,295,556	80.4	1,417	6,585,036	4,647	4.11
1943	287	17.3	1,546,956	18.8	1,369	82.7	6,680,512	81.2	1,656	8,227,468	4,968	4.32
1944	473	21.1	2,804,005	23.5	1,765	78.9	9,095,421	76.5	2,238	11,899,426	5,317	3.24
1945	613	22.7	3,508,301	26.1	2,093	77.3	9,944,302	73.9	2,706	13,452,603	4,971	2.83
1946	538	20.4	3,276,458	26.0	2,097	79.6	9,304,018	74.0	2,635	12,580,476	4,774	2.84

*In this table New Mexico data are for the southeastern part of the state only. †See Bull. A.A.P.G., Vol. 25, p. 1938, where corrections are mentioned for these figures as they appeared in Table 2, p. 1001, of the same volume.

dry holes. The average depth of hole was 4,774 ft. For comparison with statistics for this same area in 1938, 1939, 1940, 1941, 1942, 1943, 1944, and 1945, see Table 2.

In Table 3 are listed the reasons for drilling the exploratory holes in 1946, by using the best information available from men familiar with such statistics, each in his own state or district. According to these figures 1,042 exploratory holes drilled on technical advice (geology and/or geophysics) were successful, and 3,838 were dry; 23 holes, located for nontechnical reasons, were producers, and 478 were dry; 72 producers and 299 dry holes were located for reasons unknown. These figures show that 21.3 per cent of the holes drilled on technical advice were producers as contrasted with 4.6 per cent successful in the case of the holes located without technical advice. Therefore, in 1946, locations based on technical recommendations were 4.6 times as successful as those drilled without such advice.

Comparing last year's figures with figures for 1946, we note the following:

1. There was a relatively small increase (2.47 per cent) in number of exploratory holes drilled in 1946, but a decrease (3.74 per cent) in the total footage drilled.

2. There were conspicuous increases in the number of exploratory holes drilled in Illinois, Montana, and Oklahoma, and there were rather sharp drops in California, Mississippi, and New Mexico, these being considered more especially on a percentage basis rather than a well basis.

3. The average depth of hole decreased from 4,103 ft. in 1945 to 3,854 ft. in 1946.

As for several years past, again this year we shall refer to certain data pertaining to the group of 17 states. These 17 states, each year from 1938 to 1946, inclusive, have included between 98 and 99 per cent of the proven oil reserves of the country. For this reason their study gives essentially a picture of conditions in the United States where we want to compare exploration activities and additions of new oil from year to year.

In Table 4 we present an analysis of the five classes of exploratory hole and this is done both for the 17-state area and for the entire United States for 1945 and 1946. Observe that the percentages for both areas are very nearly the same for each

The accompanying extracts are taken from the author's report to the American Association of Petroleum Geologists, as chairman of the A.A.P.G. committee on exploration statistics. This report was delivered at the annual meeting in Los Angeles. Dr. Lahee is chief geologist for Sun Oil Co.

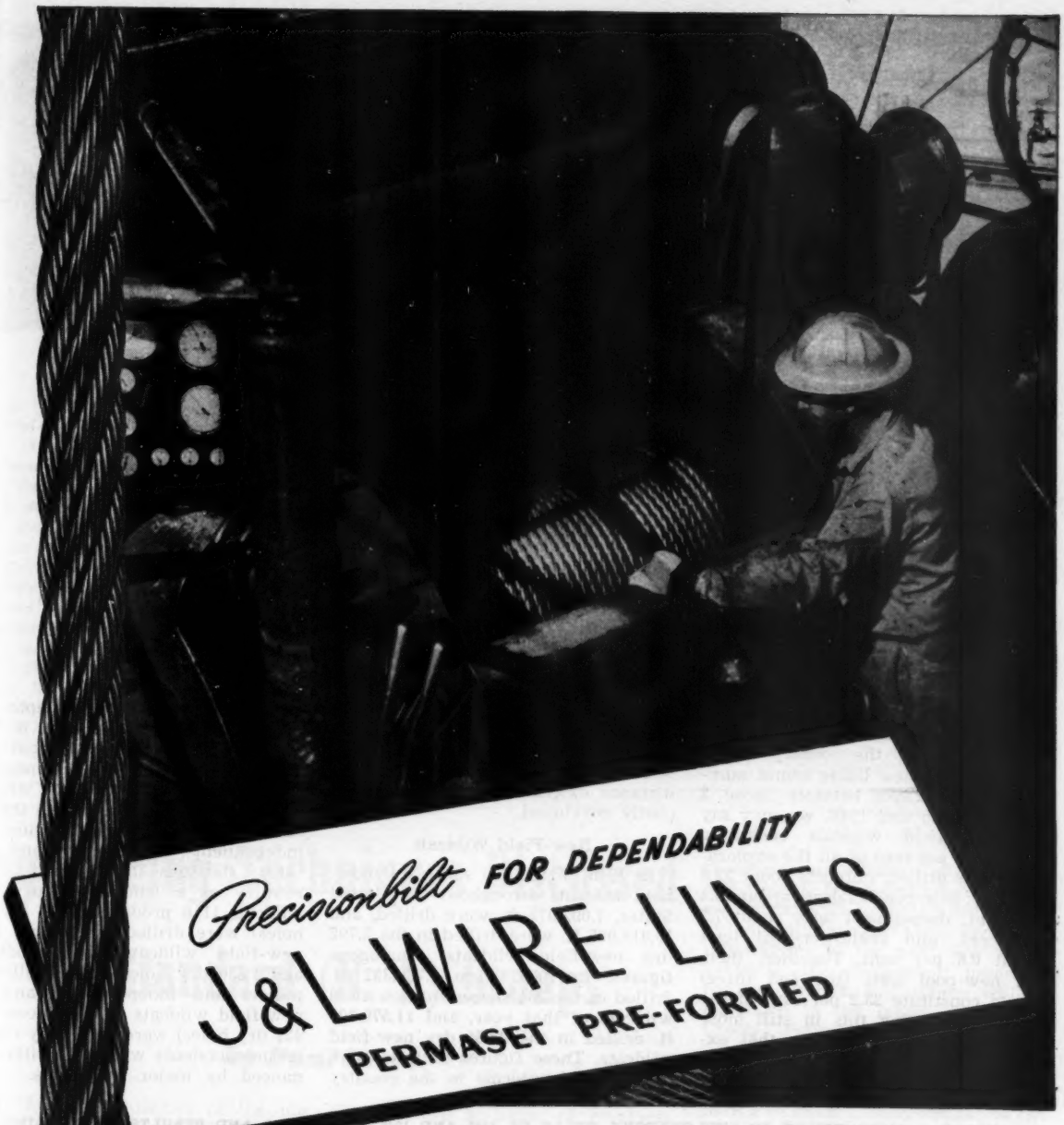

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TABLE 3—BASIS FOR LOCATING EXPLORATORY HOLES DRILLED IN 1946

State—	Geology		Geophysics*		Geology and geophysics*		Sundry nontechnical		Unknown		Totals		Grand total
	Prod.	Dry	Prod.	Dry	Prod.	Dry	Prod.	Dry	Prod.	Dry	Prod.	Dry	
Alabama	0	1	0	4	0	0	0	4	0	0	0	9	9
Arizona	0	0	0	0	0	0	0	2	0	0	0	2	2
Arkansas	6	35	4	10	2	3	0	2	0	5	12	55	67
California	55	193	5	18	8	43	1	28	1	14	70	296	366
Colorado	1	14	0	1	0	4	0	0	0	0	1	19	20
Florida	0	6	0	9	0	0	0	0	0	1	0	16	16
Georgia	0	0	0	2	0	0	0	1	0	0	0	3	3
Illinois	92	505	2	28	5	9	0	37	0	4	99	583	682
Indiana	9	70	2	2	1	1	1	18	1	20	14	111	125
Kansas	77	198	6	27	1	10	5	89	1	11	90	335	425
Kentucky	26	93	0	2	0	2	0	16	3	14	29	127	156
Louisiana	29	111	22	79	10	30	0	4	0	0	61	224	285
Maryland	0	1	0	0	0	0	0	0	0	0	0	1	1
Michigan	25	218	2	9	0	0	0	13	0	59	27	299	326
Mississippi	4	11	3	35	0	19	0	6	0	3	7	74	81
Missouri	0	0	0	0	0	0	0	0	0	6	0	6	6
Montana	15	39	0	3	1	0	1	4	1	1	18	47	65
Nebraska	0	2	0	2	0	0	0	0	0	1	0	5	5
Nevada	0	1	0	0	0	0	0	0	0	0	0	1	1
New Mexico	16	29	1	8	0	7	2	14	0	7	19	65	84
New York	1	12	0	0	0	0	0	3	0	0	1	15	16
Ohio	21	15	0	1	0	0	2	1	24	41	47	58	105
Oklahoma	51	226	46	63	12	3	3	180	4	2	116	474	590
Oregon	0	1	0	1	0	0	0	0	0	0	0	2	2
Pennsylvania	13	19	0	0	0	1	3	13	30	18	46	51	97
Tennessee	0	1	0	0	0	0	0	0	0	17	0	18	18
Texas	273	1,213	48	164	116	180	2	32	3	74	442	1,663	2,105
Utah	0	4	0	0	0	0	0	4	0	0	0	8	8
Virginia	0	0	0	0	0	0	0	0	0	1	0	1	1
Washington	0	0	0	1	0	0	0	0	0	0	0	1	1
West Virginia	16	11	0	0	0	0	2	2	4	0	22	13	35
Wyoming	12	24	1	4	2	0	1	5	0	0	16	33	49
Total	742	3,053	142	473	158	312	23	478	72	299	1,137	4,615	5,752

*Including geochemistry.

year. This, of course, would be expected since so much of the exploratory drilling of the country occurs in these 17 states. Using round numbers for averages between these 2 years of 1945 and 1946, we may say that new-field wildcats constitute about 54.2 per cent of all the exploratory holes drilled; outposts about 22.6 per cent; new-pool wildcats about 15.4 per cent; deeper-pool tests about 7.2 per cent; and shallower-pool tests about 0.6 per cent. Together, then, the new-pool tests (the last three) would constitute 23.2 per cent of the total. Or, putting this in still more general form, we may say that exploratory drilling is roughly divisible into 54 per cent which is wildcatting for new fields, 23 per cent which is drilling for new pools on structures already producing, and 23 per cent which is outpost drilling for long-distance extensions of pools already partly developed.

New-Field Wildcats

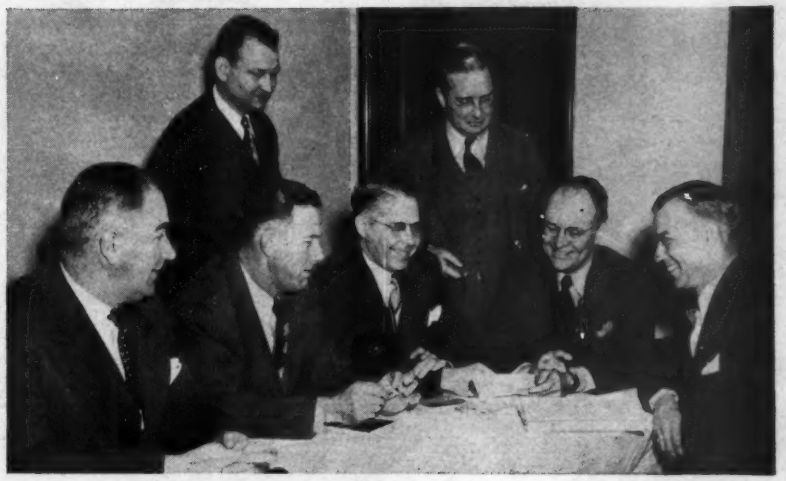
In 1946, in the 333 successful new-field wildcats throughout the United States, 1,692,977 ft. were drilled, and 10,818,985 ft. were drilled in the 2,792 dry new-field wildcats. Analogous figures, in 1945, were 1,789,392 ft. drilled in the 351 successful new-field wildcats of that year, and 11,579,395 ft. drilled in the 2,685 dry new-field wildcats. These figures indicate that, in new-field wildcats in the country as a whole, the average depth was 4,403 ft. in 1945 and 4,004 ft. in 1946.

A question sometimes asked concerns the approximate percentage of true wildcatting (new-field wildcatting) by major companies, on the one hand, and by minor companies and independents, on the other hand.

Our statistics showed that in the country as a whole, 659 new-field wildcats (118 producers and 541 dry holes) were drilled by majors; 1,991 new-field wildcats (161 producers and 1,830 dry holes) were drilled by minors and independents; and 475 new-field wildcats (54 producers and 421 dry holes) were drilled by minors or independents with the drilling financed by major companies.

TABLE 4—DISTRIBUTION OF EXPLORATORY WELLS OF 1945 AND 1946 BY CLASSES AND RESULTS OF DRILLING

	17-States area						All states reported					
	1945			1946			1945			1946		
	No.	Well per cent	Class per cent	No.	Well per cent	Class per cent	No.	Well per cent	Class per cent	No.	Well per cent	Class per cent
Outposts:												
Producers	424	38.09	....	374	29.40	....	480	39.57	....	424	31.26	....
Dry holes	689	61.91	....	898	70.60	....	733	60.43	....	933	68.74	....
Totals	1,113	100.00	21.07	1,272	100.00	23.38	1,213	100.00	21.61	1,357	100.00	23.57
New pool wildcats:												
Producers	207	25.30	....	223	29.95	....	236	26.14	....	271	31.88	....
Dry holes	611	74.70	....	545	70.05	....	767	73.86	....	579	68.12	....
Totals	818	100.00	15.49	778	100.00	14.30	903	100.00	16.09	850	100.00	14.77
Deeper-pool tests:												
Producers	106	26.56	....	80	21.56	....	114	27.08	....	85	21.73	....
Dry holes	293	73.44	....	291	78.44	....	307	72.92	....	306	78.27	....
Totals	399	100.00	7.55	371	100.00	6.81	421	100.00	7.50	391	100.00	6.79
Shallower-pool tests:												
Producers	32	82.06	....	21	80.77	....	33	82.50	....	24	82.75	....
Dry holes	7	17.94	....	5	19.23	....	7	17.50	....	5	17.25	....
Totals	39	100.00	.74	26	100.00	.50	40	100.00	.71	29	100.00	.53
New-field wildcats:												
Producers	335	11.50	....	313	10.45	....	351	11.37	....	333	10.65	....
Dry holes	2,578	88.50	....	2,680	89.55	....	2,685	88.63	....	2,792	89.35	....
Totals	2,913	100.00	55.15	2,993	100.00	55.01	3,036	100.00	54.09	3,125	100.00	54.34
Total producers	1,104	20.90	....	1,021	.....	....	1,214	21.63	....	1,137	.....	....
Total dry holes	4,178	79.10	....	4,419	.....	....	4,399	78.37	....	4,615	.....	....
Grand total	5,282	100.00	100.00	5,440	100.00	100.00	5,613	100.00	100.00	5,752	100.0	100.00



Chicago technical committee meeting of Standard Oil Co. (N. J.), production department. Above: Roger S. Sherman, Creole Petroleum Corp., New York; Howard W. Page, Standard Oil Co. (N. J.), New York; M. L. Haider, Imperial Oil, Ltd., Toronto; C. E. Reistle, Humble Oil & Refining Co., Houston; Loren F. Kahle, Interstate Oil Pipe Line Co., Tulsa; J. R. McWilliams, Carter Oil Co., Tulsa. Right (Sitting): Ralph P. Bolton, Standard Oil Co. (N. J.), New York; L. F. McCollum, Standard Oil Co. (N. J.), New York; Ivan S. Salnikov, Standard Oil Co. (N. J.), New York; G. M. Knebel, Standard Oil Co. (N. J.), New York; H. W. McCobb, Standard-Vacuum, New York. (Standing): M. A. Wright, Standard Oil Co. (N. J.), New York; T. V. Moore, Standard Oil Development Co., New York

Engineering Techniques Discussed By Standard (N. J.) Groups

by Paul Reed

CHICAGO.—Techniques of the job of discovering, producing, and transporting oil were discussed in the meeting here March 17-21, attended by 250 executive and technical men of Standard Oil Co. (N.J.), subsidiary and affiliated companies representing world-wide operations. For this occasion 20 per cent flew from countries outside the United States.

Interchange of ideas for the development and application of techniques and improvements which will keep costs down was the objective of the meeting, according to L. F. McCollum, coordinator of production for Standard Oil Co. (N. J.), who was general chairman of the meeting. Modern technology has resulted in lower costs in recent years. Future research is expected to arrest rising costs and even to achieve constantly lower costs without reducing the standard of living of employes.

Among those present were: Chester F. Smith, vice president and director, Standard Oil Co. (N. J.); Ralph V. Hanrahan, president, Humble Pipe Line Co.; C. R. Younts, president, Plantation Pipe Line Co.; and Loren F. Kahle, president, Interstate Oil Pipe Line Co.

While drilling costs are not expected to rise this year, Jersey is undertaking a job of counteracting an indicated trend toward increased drilling costs in the future. According to C. E. Reistle, manager of production, Humble Oil & Refining Co., deeper drilling is coming. Starch mud and silica mud are making it possible to extend the search for oil into difficult territories. As fields become harder to find, the cost of discovery becomes steadily greater, percentagewise, among other producing costs.

Because of the growing difficulty of discovering oil the Carter Oil Co. and Humble Oil & Refining Co., Jersey subsidiaries in the United States, are planning larger exploration appropriations in the next few years. Likewise the exploration programs for the Western Hemisphere will be expanded in the search for oil by Creole Petroleum Corp., International Petroleum, Ltd., and Imperial Oil, Ltd. This is being done at the same time that the company is preparing to extend its operations in the Middle East. Little advance is expected in the volume of Arabian crude until the completion of the Trans-Arabian pipe-line project; this is due to present high transportation costs to refineries capable of handling it.

The upward trend in drilling costs demonstrates clearly the need for radical improvements in equipment and techniques and, therefore, far greater and better coordinated research effort which might effect savings of millions of dollars in a year's drilling program, according to Ivan S. Salnikov, coordinator of petroleum engineering and equipment, Standard Oil Co. (N. J.) With better rigs, 13,000 ft. and deeper wells would be drilled at costs lower than the costs today. A rig capable of drilling 20,000 ft. will become available in 2 or 3 years. Present indications are that

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20,000-ft. wells would cost $500,000 to $750,000 per well.

Preparing for exploration of the Continental Shelf when oil may be produced there in competition with other oil, Humble has engaged an oceanographer to advise on marine structures. The well of Humble Oil & Refining Co. to be drilled soon, 8 miles from the shore of Grand Isle, La., will be in a water depth of 50 ft., at which wave action is regarded by authorities as most severe. Lake Maracaibo methods are adapted to sheltered waters with a muddy bottom but not to the rifts and sands of the Gulf Coast. Standard steel H-beam piling for rig foundations is expected to withstand heavy wave action in water depths up to 100 ft. For deeper water out to the 600-ft. maximum depth of the Continental Shelf, a floating structure would be used of the sea-drome type, having the heaviest part submerged.

In reviewing exploration activities abroad, several interesting developments were cited including the 3,500-bbl. daily field in Holland developed with Shell, in which Jersey has a 50 per cent interest. Some preliminary work has been done for exploring in Italy. Efforts may be accelerated in the near future in Hungary and Romania, where the company has been operating under difficulties imposed by price and production control imposed by Russian officials. In its world-wide activities, the sun never sets on Jersey producing operations.

Search for oil in the Canadian Northwest has been stimulated by Imperial's recent discovery near Edmonton, according to M. L. Haider, manager of production operations, Imperial Oil. *(For a picture of this well see page 63.)*

In exploration sessions the results of basic research to recognize and discover source beds for oil were presented in a report on hydrocarbons of the Uinta basin. While knowledge of the origin of oil is still limited, the industry does not yet know how to recognize source beds. Further knowledge will be of aid in determining oil migration, once a source bed has been found. Such basic research parallels similar projects of other companies aimed at developing the science of petroleum geology.

In the search for stratigraphic traps greater emphasis is being put on utilizing more of the data available from reflection seismograph surveys in order to derive maximum benefits from interpretational work for this type of exploration.

Limestone-reservoir data was reviewed preliminary to studies of this significant subject which the company is initiating as a basic research project. Progress reports were presented on current projects: thermal prospecting to determine relationships between temperature and structure; and a geochemical study of the Woodbine basin in East Texas utilizing water analysis.

Oil occurrence and accumulation in basins, in trends, and unconformities were treated as well as micropaleobotanical research, the airborne magnetometer, gravity-meter surveys, seismograph and electrical prospecting.

In dealing with well completions attention was directed to the consolidation of loose sands by chemical treatment pioneered by Humble; and comparative efficiency of twin-well and multiple-zone completions in Illinois. Emphasis was placed on the large money savings which would result from more extensive well-cementing research.

Problems of thin-section oil sands, repressuring, reservoir conditions, gas-condensate systems, and corrosion of production equipment received attention.

Drilling discussions covered diesel-electric and heavy-power rigs; mud control; factors affecting the rate of drilling; and preliminary studies on Continental Shelf drilling; recent coring of hard limestones with diamond bits and the development of automatic drilling machinery.

Pipe-line discussions were directed toward furnishing low-cost transportation under the best operating conditions. Consideration was given to short-wage radio communication; operation of diesel units without standby equipment; hydraulic calculations, corrosion; tankage; and control of products contamination.

Approximately half of the discussions were on subjects dealing with exploration for new fields and occurrence and accumulation of petroleum. Value of broadening the research programs and improving techniques was stressed repeatedly during the meeting in the efforts toward lower costs.

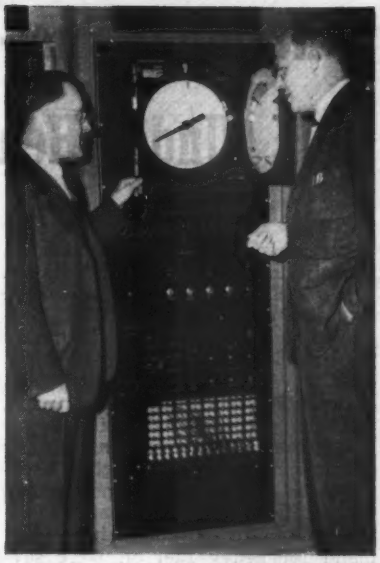
The meeting was held in Chicago because of the ample facilities available for accommodations. Most of the men from abroad flew to Chicago immediately preceding the meeting and returned to their operations the day after it was concluded.

Pool Analyzer Built for California Research Corp.

An oil-pool analyzer of the type developed by Carter Oil Co. has been manufactured in Tulsa and shipped to the West Coast where it will be used by California Research Corp.

The analyzer, which projects production capabilities of a field 25 years or more, is the first placed in service under Carter's offer to make available plans and specifications of the device to the industry, royalty free.

California Research Corp. is a subsidiary of Standard Oil Co. of California. Several other companies are planning to take advantage of Carter's offer.



William Schautelberger, electronics engineer, and Dr. Phil Williams, head of Carter Oil Co.'s research laboratory, in front of the central control panel of the oil-pool analyzer

The California Research analyzer was manufactured in Tulsa by Coleman Instrument & Manufacturing Co. For its trip to Whittier, Calif., the 3,000-lb. instrument rode in a private express car. Housed in a 7-ft. high steel case, it has 2,800 sockets and plugs which when connected and arranged in combinations can duplicate water and gas pressure conditions.

The analyzer was demonstrated at Tulsa in May 1946 by Dr. W. A. Bruce, Carter physicist and inventor. *(The Oil and Gas Journal, May 11, 1946, page 90.)*

Crude Imports Show Gain, Exports Drop

Daily average imports of crude petroleum showed an increase of 17,226 bbl. during January, compared with December, while daily average crude exports showed a drop of 32,677 bbl.

Exports of both motor fuel and gas oil and fuel oil showed marked decreases, while imports of gas oil and fuel oil showed a considerable gain. Comparisons of imports and exports in January and December are shown in the following table:

IMPORTS
(Daily average, barrels)

	January 1947	December 1946
Crude oil	288,903	271,677
Gas and fuel oil	202,387	171,871
EXPORTS		
Crude oil	81,581	114,258
Gas and fuel oil	51,935	67,903
Motor fuel	81,806	108,839

Residual Fuel-Oil Prices Soar Under Heavy Demand

PRICES at which residual fuel oil was traded in some spot-market transactions reported this week in the Mid-Continent area approached those posted for crude-oil itself, providing a feature in the all-around tight market for petroleum products.

No. 6 residual fuel oil was quoted at from $1.55 to $1.65 per barrel in market reports, but sales officials reported some material moving at $1.85 and in some cases even higher. Present price of Oklahoma-Kansas crude, 40 gravity and above, is $1.95.

Back of the extremely heavy demand for heavy fuel oil were several apparent factors. Much of the demand appeared to be originating from industrial concerns which recently suffered a cut in natural-gas fuel supplies. Some of these converted from coal last winter. Also, to meet gasoline demand, many refiners are reported to be reducing residual supply by maximum cracking.

The market for other products, in the Mid-Continent as well as throughout the remainder of the country, continued to move upward. Gasoline, regular grade, Group 3, was quoted at from 8 to 8¼ cents. Some slight easing of the motor-fuel market was indicated as suppliers who held off in the rising market now accepted orders for their material. No. 2 fuel oil, Group 3, was quoted at 6⅛ to 6⅜ cents, but spot sales at 6⅝ cents were reported.

Natural Gasoline Responds

Natural gasoline responded to the gasoline increases. Group 3 natural gasoline was moving at 5⅜ cents; and at 4⅞ cents, North Texas, both for the 26-70 grade.

Standard Oil Co. (Ind.) made a second ½-cent advance in normal and subnormal consumer and dealer tank-wagon prices on all grades of gasoline and naphtha. The increase was effective March 26.

An increase in products prices in Canada was indicated following the removal of price ceilings on the petroleum group April 1. Imperial Oil, Ltd., pointed out adjustments may be made in view of the increases in crude prices, both in the United States and Canada.

In New York, residual and No. 5 fuel-oil supply was reported tight. Demand was also good for No. 2 and kerosene. Standard Oil Co. of New Jersey announced increases effective March 21 on principal products as a result of the March 10 crude advance. The increases applying throughout the company's marketing area amounted to 0.8 cent on all grades of motor fuel, 0.7 cent on kerosene, and 0.6 on heating oil and diesel. Bunker fuel oil and other residual fuel advanced 20 cents per barrel.

Jersey Standard Abandons Atlantic Coast Test

MANTEO, N. C.—Standard Oil Co. of New Jersey has abandoned its offshore test 11 miles south of Roanoke Island. No trace of oil was reported found in the well, which was bottomed at 6,410 ft., about 1,000 ft. in the lower Cretaceous.

First underwater drilling experiment along the Atlantic Coast, the test was spudded in January 7.

Herndon David Now Heads Journal's California Office

Herndon David, a member of the editorial staff of The Oil and Gas Journal and Petroleo Interamericano for several years, is now in charge of the California editorial office of the two publications with headquarters at 1406 South Grand Avenue, Los Angeles.

David joined the Journal staff, working in the field department, while attending the petroleum-engineering school of the University of Tulsa. During the war, he served with the Army Air Force as a lieutenant and a bomber pilot. He was credited with 32 actual combat missions over Germany and was awarded six medals for his work with the 569th Bomber Squadron. Following his discharge from the service, he has been engaged in field and engineering writing and also has completed work for a degree in petroleum engineering at the University of Tulsa.

HERNDON DAVID

Shell Buys 96 Producing Wells From Adkins Firm

Properties of Adkins Oil Associates, oil-producing partnership of Tulsa and Benton, Ill., were purchased last week by Shell Oil Co., Inc., for a sum unofficially reported to be about $3,000,000.

The properties include 96 producing wells near Benton, in Franklin County, Ill., with a daily crude output of 1,100 bbl. J. V. Howell, partner in the Adkins firm, said the partnership has been dissolved.

DEATHS

William E. Harrison, 68, retired lease broker, died March 17 in Tulsa.

Emanuel W. Hartman, 66, oil-well repressuring contractor, died March 18 in a Tulsa hospital. He entered the oil business in the early 1920's.

L. L. Prock, 53, associated with Ohio Oil Co. in the lease department, died March 16 at his home in Tallahassee, Fla.

J. S. Davis, 40, drilling production superintendent for Jay Simmons, Dallas, died March 13 in Corpus Christi, Tex.

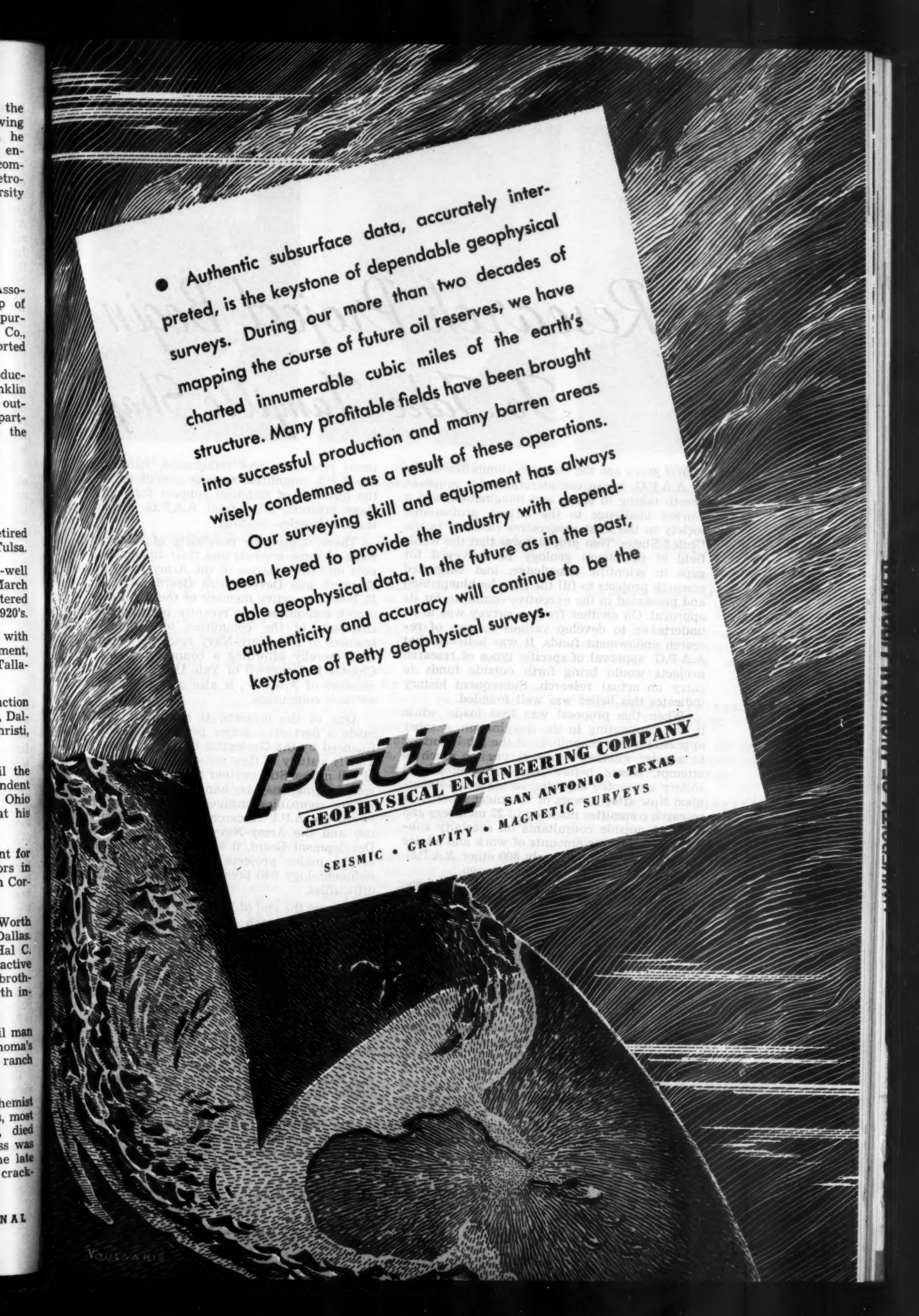
Walter Gundelfinger, 60, until the first of this year a superintendent of the main-lines division of Ohio Fuel Gas Co., died March 18 at his home near Wellston, Ohio.

A. H. Hince, 52, superintendent for Stroube & Stroube, oil operators in Corsicana field, died March 17 in Corsicana, Tex.

W. J. Richardson, 54, Fort Worth oil man, died March 21 in Dallas. Richardson was a partner of Hal C. Peck, Midland, Tex., and was active in West Texas fields. He was a brother of Sid Richardson, Fort Worth independent operator.

Wallace Doolin, 83, pioneer oil man who drilled several of Oklahoma's first wells, died March 21 at his ranch near Oilton, Okla.

Dr. Roy Cross, scientist and chemist who held more than 100 patents, most of them in the oil industry, died March 21 in Kansas City. Cross was coinventor with his brother, the late Dr. Walter Cross, of a thermal cracking process.


● Authentic subsurface data, accurately interpreted, is the keystone of dependable geophysical surveys. During our more than two decades of mapping the course of future oil reserves, we have charted innumerable cubic miles of the earth's structure. Many profitable fields have been brought into successful production and many barren areas wisely condemned as a result of these operations.
Our surveying skill and equipment has always been keyed to provide the industry with dependable geophysical data. In the future as in the past, authenticity and accuracy will continue to be the keystone of Petty geophysical surveys.
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Vast Research Project Begins To Take Tangible Shape

TWO years ago the research committee of the A.A.P.G. began consideration of a proposal, breath taking in scope and imagination, and a worthy challenge to the largest professional society in the most progressive industry in the United States. That proposal was that the whole field of petroleum geology be surveyed for gaps in scientific knowledge, and suggested research projects to fill the gaps be blueprinted and presented to the executive committe for its approval. On another front, a survey was to be undertaken to develop various sources of research endowment funds. It was believed that A.A.P.G. approval of specific types of research projects would bring forth outside funds to carry on actual research. Subsequent history indicates this belief was well founded.

When this proposal was first made, while it was captivating to the imagination, a sober appraisal of the magnitude of the job led many to wonder whether or not it was too much to attempt. Never before had any professional society attempted anything so big and so complex. Now after 2 years of volunteer labor by a research committee made up of 23 members and some 30 outside consultants on specialty subjects, plus varying amounts of work and advice from time to time by nearly 300 other A.A.P.G. members, tangible results can be seen.

It has been proved that the job can be done, although its completion will require the work of many able men for several years to come. At Los Angeles this week, the research committee presented 10 research projects in complete outline to the executive committee for final A.A.P.G. sanction. Two more projects were not complete enough for presentation at this time. It seems quite likely that formal approval will be forthcoming for most of the projects.

Although questions of placement and financing of the projects are necessarily deferred, pending final sanction of the A.A.P.G., it is known that the A.P.I. research committee, with endowment funds at its disposal, is interested in several of the projects. A preview of the A.A.P.G. work was presented to the A.P.I. committee at the annual A.P.I. meeting in Chicago last November. At that time the A.P.I. committee was so impressed that a very unusual procedure was established, namely for the A.P.I. committee to take a mail ballot on the question of financial support for some of these projects, after final A.A.P.G. action at the Los Angeles meeting.

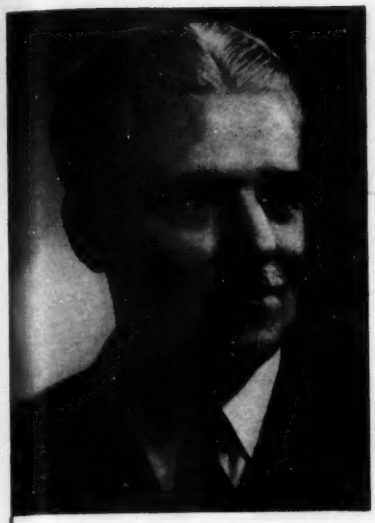
There is also the possibility of integrating some of these projects and their financial support into the program of the Army-Navy Joint Research and Development Board. Dr. Roland F. Beers, an active member of the A.A.P.G. research committee, has recently been appointed chairman of the committee on geophysical sciences of the Army-Navy research organization, thereby affording a connecting link. Dr. Chester R. Longwell of Yale University, and a member of A.A.P.G., is also a member of the military committee.

One of the projects, if approved, will be made a part of a larger project that will be financed by the Geological Society of America. This is a study of flow structure in the interior of salt mines. Still another project, dealing with well logging, may be handled or financed by service companies engaged in such work. Between the A.P.I. research committee possibilities and the Army-Navy Joint Research and Development Board, it is apparent that several of the major projects in various aspects of sedimentology will present no serious financing difficulties.

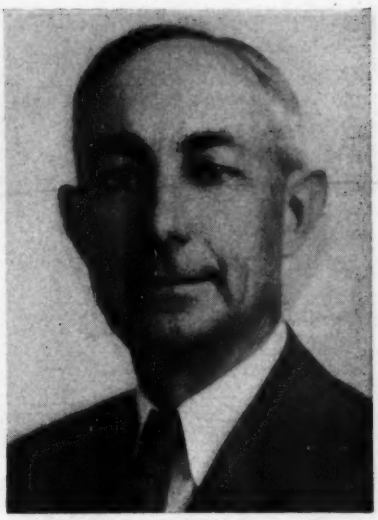
Thus at the end of 2 years of extremely hard work, the research program begins to take tangible shape, and as anticipated, funds to support such carefully worked out projects seem to be available from numerous sources. Moreover, the whole plan seems to gain momentum as it develops. Now that it can be seen that success is eventually possible, the size and scope of the whole project are definite advantages, There is some phase and some place in the project for every scientist's pet problem. The result is that more and more members of the A.A.P.G. are taking an active interest and devoting much time and effort to assisting the main committee.

The following are brief abstracts of the projects that are being submitted to the executive committee this week for final approval:

By CHARLES J. DEEGAN



SHEPARD W. LOWMAN
Chairman Research Committee



G. C. GESTER
Chairman Subcommittee on Reservoir Fluids

W. C. KRUMBEIN
Chairman Subcommittee on Sedimentation

TWELVE SUBJECTS SCHEDULED FOR STUDY

1. **"Clay Minerals Project."**—By Roland F. Beers.

The identification description, parameters, and behavior of clay minerals in sedimentary rocks as related to all types of well logging, core analysis, reservoir behavior, source beds of petroleum, base exchange, indices of sedimentation environment and variation in permeability, porosity, and fluid saturation with burial and compaction.

2. **"Evolution of Hydrocarbon Project."**—By F. M. Van Tuyl.

A proposal to get samples and cores from a well drilled in Gulf of Mexico, beginning with surface ooze and at regular intervals up to about 2,000 ft. Examination of these samples to determine changes related to increasing depth in lithologic character, compaction, general constitution and modification of organic debris, interstitial water, bacterial flora, nature of oily substances, amount of gaseous hydrocarbons and relation to organic matter, oil substances, variations in radioactivity and relation to mineral composition, lithologic character, organic matter content, gaseous hydrocarbons, oil substances, etc.

3. **"Formation Waters Project."**—By Leslie C. Case.

A proposal to select two geological basins of widely divergent history and study all existing water analyses as well as about 100 to 200 new ones in each basin and determine the significance of formation-water characteristics to other geological occurrences. Also proposed that in addition to usual analyses for Palmer determination, attempts should be made to develop uncommon characteristics to see if these are significant. Separate determinations of Na and K, ammonium, Ba and Sr, and determination of organic acids in terms of naphthenic acid, are suggested.

4. **"Bacteria Project."**—By Claude E. ZoBell.

Investigations proposed to help appraise the part played by bacteria in the diagenesis of sediments with particular reference to petroleum.

5. **"Recent Clastic Sediments Project."**—By S. W. Lowman.

The investigation of sediments of the northwestern part of the Gulf of Mexico with reference to the physical, chemical and biological factors in the environment, deposition and diagenesis.

6. **"Ancient Sediments Project."**—By W. C. Krumbein.

Comprehensive study of the sediments of a single limited stratigraphic section over a considerable area.

7. **"Carbonate Reservoir Project."**—By W. C. Imbt.

The study of the nature and manner of origin of porosity and permeability in the carbonate group of rocks.

8. **"Cementation Project."**—By W. A. Waldschmidt.

The investigation of the cementation of sedimentary rocks and its bearing on oil occurrence.

9. **"Salt Dome Project."**—By Robert Balk.

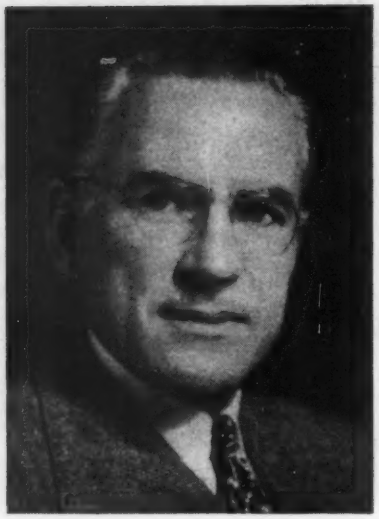
Mapping the flow structure on the interior of salt mines, Texas and Louisiana.

Projects 10 and 11 not yet completed.

12. **"Well Logging Project."**—By G. E. Archie.

It should be possible to develop relationships and expansion of interpretation of electric and radioactive logging to aid in other research problems, such as (a) clastic and carbonate projects; (b) reservoir-water analyses. Also, in combination with cores and other subsurface data from a known area, it may be possible to develop methods by which local variations can be used to postulate general regional geological conditions in a new region, where only electric or radioactive log data are available.

EARL B. NOBLE
Retiring president, A.A.P.G.



FRANK A. MORGAN
Presents address of welcome

ALEXANDER DEUSSEN
Recipient, Sidney Powers Award

Three Exploration Societies Meet in California With Heavy Schedule

by Charles J. Deegan

LOS ANGELES.—Ten years have elapsed since the exploration scientists of the oil industry last met here for the joint annual meeting of the American Association of Petroleum Geologists, Society of Exploration Geophysicists, and the Society of Economic Paleontologists and Mineralogists.

But some things appear to change very little. The genuinely enthusiastic hospitality of the host California scientists, and their energetic efficiency in preparing everything down to the last detail—these have not changed. The attendance, expected to reach, perhaps exceed 1,800 when the final tally is in, sets a new record for California, but setting a new record is not a change, merely following precedent.

There are some changes in the faces, some new, some older ones showing the strain of the war years. But there is no change in the mental attitude. Each year seems to bring the same story, a large area of hitherto unknown scientific territory brought within the realm of the explored and mapped; yet a ferment of new ideas and a scientific humility of thought resulting from the knowledge of how much vaster than previously thought is the unknown territory still to be explored. This year, it can be truly said that never was there such a ferment, such a stirring of ideas, such a vision of things that can be achieved, such a widespread rising to the challenges of recognized problems.

Ten years ago when these scientists met here they represented an industry producing 3½ million barrels daily in the United States and 2 million barrels in the rest of the world. Today they are responsible for maintaining and increasing a domestic production of 5 million and a foreign production of 3 million barrels, with the whole world crying for more oil. The differences resulting from that increased responsibility are easy to detect. It is not a problem to be solved by mere increase in numbers, important though that subject is in a world that lost 4 to 6 years' crops of university graduates in the fields of science.

The effect of these problems on the scientist's thinking was exemplified in the meetings of the A.A.P.G. research committee, which was the first to get under way, on Sunday. It was highlighted in President Noble's address to the joint meeting on Tuesday morning. He told about the number of areas about which we still know very little, because of a cover that masks the underlying geological conditions; a cover that cannot be penetrated effectively by our present prospecting tools or exploration methods. Sometimes the obstacle to penetration of the cover is economic, but often it is because of physical difficulties; physical problems, in which nature has established barriers to unraveling her subsurface secrets; barriers which to date, the geologist, geophysicist, and paleontologist have not succeeded in overcoming.

A Challenge Presented

These areas present a challenge to all exploration scientists. If the barrier is economic considerations, perhaps new instruments, new techniques can be devised to attack these problems in a less costly way. If the barrier is physical, something beyond the limitations of present instruments and methods, then again the answer is to think of new instruments, new techniques, to stimulate the imagination of the men who must solve the problem.

Pursuing the same subject from a different angle, Noble then called attention to another type of mask, namely, that existing in the minds

Convention committeemen at one of their last meetings before the opening of the annual meeting. Back row: J. C. Hazzard, field trips; H. J. Steiny, transportation; C. H. Johnson, vice chairman S.E.G. arrangements; V. W. Vandiver, hotels and housing; W. P. Winham, exhibits; E. R. Atwill, entertainment; H. L. Driver, program S.E.P.M., and V. L. King, registration. Front row: H. C. Pyle, general vice chairman; C. R. McCollom, reception; H. W. Hoots, general convention chairman; Mrs. C. M. Wagner, ladies' entertainment; Earl B. Noble, national president, A.A.P.G.; R. W. Clark, technical program, and G. R. Bell, publicity

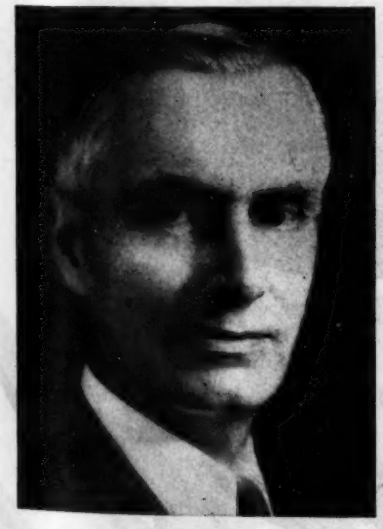
of men. Mental prejudices have sometimes played a part in retarding the discovery of new oil fields. He listed several ideas held in the past about why there could be no oil found where certain conditions existed, and the confusion of those who held such ideas when oil fields were later found under just such conditions.

He called on the exploration scientists to reexamine their thinking and penetrate the mask of prejudices, so that they would recognize them as such and not mistake them for scientific conclusions.

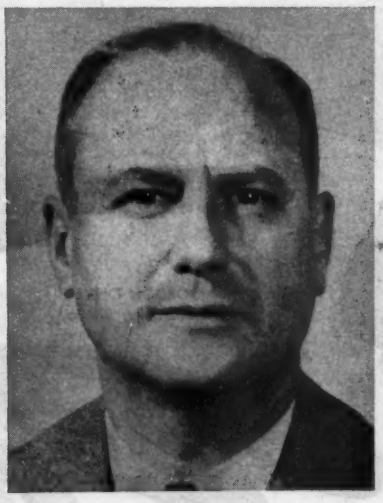
President F. W. Rolshausen, of the S.E.P.M., exemplified the new trend in a specific manner in his address to the joint meeting, when he discussed the environmental conditions during the deposition of several formations in the ancient Gulf of Mexico. His talk embraced the entire region from southwestern Texas and the Rio Grande embayment to South Florida as a geologic unit, of which the South Florida, North Florida, South Georgia and southern Alabama, Mississippi embayment, East Texas basin, and Rio Grande embayment were considered as subdivisions of one overall environmental region.

He pointed out that deposits of any one geological formation have a highly variable composition from the Rio Grande to Florida, and displayed maps to illustrate them. The contemporaneous deposits of fossiliferous and nonfossiliferous sands and shales, red beds, chalks, limestone, dolomites, anhydrite, and salt, seem to have depended to a large extent on the amount of rainfall on the land areas surrounding the ancient gulf.

West of the Appalachians, during Lower Cretaceous and up to and including Eagle Ford times, the major source of sediments seems to be from rivers entering the Gulf from the north and northeast; on the east side of the Appalachians, from rivers arising to the northwest and west. After Eagle Ford times, the major source of sediments was from rivers



F. H. LAHEE
Recipient, Honorary Member Award



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Gulf Oil Corp.

Reed

New officers of the A.A.P.G.: C. E. Dobbin, president; George S. Buchanan, vice president; J. V. Howell, secretary-treasurer, and C. L. Moody, editor

entering the Gulf from the west; rivers that probably drained the major portion of the western part of the present Mississippi River Basin. There is evidence that an ancient Rio Grande River was the main source of sediments during later Upper Cretaceous, Eocene, Oligocene, and Lower Miocene, and that the Mississippi River contributed very little to the sediments of the Gulf region until late Upper Miocene times.

The Sidney Power memorial medal award of the A.A.P.G. was presented to Alexander Deussen, consulting geologist of Houston, with this citation: "For his outstanding contributions to the geology of the important oil-producing regions of the Gulf Coast of Texas and Louisiana, and for advancing the profession of petroleum geology through encouragement and active assistance generously given to the younger members of the profession."

In recognition of "distinguished service to the cause of petroleum geology," Dr. Frederic H. Lahee, of Dallas, and Dr. William H. Twenhofel, of Madison, Wis., were elevated to the rank of honorary membership in the A.A.P.G. During the past 23 years, the A.A.P.G., with a membership of 5,000, has previously bestowed this honor upon only 29 members.

The A.A.P.G. "President's award" for the most significant geological paper published in the association's monthly Bulletin during 1946 by a younger man, carrying with it a prize of $100, went to Dr. Robert F. Walters, of Tulsa, for his paper, "Buried Pre-Cambrian Hills in Northeastern Barton County, Kansas," published in the May 1946 Bulletin.

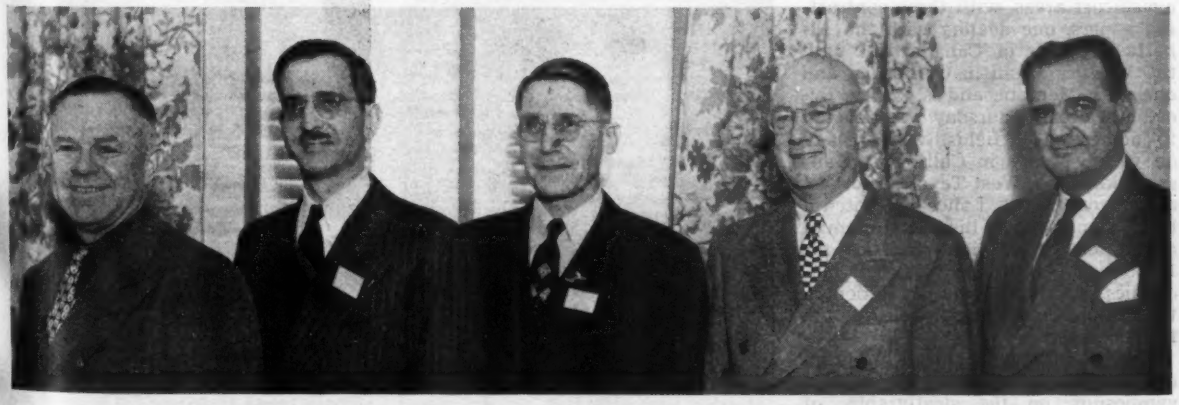
The S.E.G. main program got under way on Tuesday, as part of the joint meeting in the forenoon. In the afternoon the annual business meeting was held, with reports from the various business committees, including the one on a new constitution and by-laws, which, among other things, will encourage the establishment of local sections. This was followed by a session devoted largely to airborne-magnetometer and radar papers.

Joint Technical Session

The Wednesday morning program was again a joint technical session with the A.A.P.G., when both geological and geophysical papers were presented on the Pacific Basin. In the afternoon, a large number of the members visited the seismological laboratory of the California Institute of Technology. On Thursday, the number of technical papers was so large that the meeting split into two sections for both morning and afternoon sessions. One section devoted the morning session to case-history papers, the afternoon largely to papers on gravity and instruments. The other section spent the morning with papers on electrical problems and general seismic papers. Its afternoon session was devoted to papers on seismic operations in water, and multiple-reflection seismic papers.

After heavy committee meeting schedules Sunday and Monday, the A.A.P.G. open sessions started Monday night with a general symposium on sedimentation in small, deep basins, such as are found on the Pacific Coast. This same theme in more specific application was carried through in the Tuesday afternoon session in papers on the genesis and evolution throughout Tertiary time of the Los Angeles and Ventura basins and the Great Interior Valley.

The Tuesday morning business session also included running accounts



Here are members of the 1946-1947 executive committee of the A.A.P.G., which retires following the Los Angeles meeting. The men are Gayle Scott, editor; E. A. Koester, secretary-treasurer; M. G. Cheney, past president; Earl B. Noble, president; D. Perry Olcott, vice president

CANDIDATES FOR ELECTION AT S.E.G. CONVENTION

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For editor

FREDERICK ROMBERG
For editor

of the highlights of domestic and foreign developments during 1946. The Wednesday program was devoted to discussions of the geology of lands bordering the Pacific, including China, Japan, the Philippines, New Zealand, Central America, Peru, Ecuador, and Chile.

Wednesday night, a session was held on petroleum prospecting in overthrust areas, with three contrasting papers, one dealing with the Alberta Foothills of Canada, one with the Ventura Basin in California, and one with Montana and Wyoming overthrust areas. Thursday was devoted to domestic oil fields, with papers on various fields in California, Kansas, Oklahoma, West Texas, Colorado, and Wyoming. Dr. Lahee presented a brief summary of his usual annual article on exploration statistics for 1946. A paper on the historical mechanics of Clinton sand deposition in the Appalachian region closed the formal program.

The S.E.P.M. technical program opened Wednesday morning, with a symposium on the stratigraphy of California, including discussions of the Los Angeles and Ventura basins, the Santa Maria district, the Sacramento, Great, and San Joaquin valleys. The afternoon session was dominated by papers on paleontological problems in Colombia, Ecuador, and the Dominican Republic.

HENRY C. CORTES
Retiring member, S.E.G. executive committee

F. W. ROLSHAUSEN
Retiring president, S.E.P.M.

DIGESTS

EXPLORATION SOCIETIES' ANNUAL MEETING

On this and the following eight pages are presented digests of most of the papers presented before the annual meetings of the American Association of Petroleum Geologists, the Society of Exploration Geophysicists, and the Society of Economic Paleontologists and Mineralogists. Meetings were held at Biltmore Hotel, Los Angeles, March 25-27.

The Pseudo Shoreline of The Repetto Formation

MANLEY L. NATLAND, Richfield Oil Corp., Long Beach, Calif.

DATA from several lines of evidence indicate that the Repetto formation was laid down in water at least 5,400 ft. deep. Therefore, the buried and uneroded margin of this formation on the eastern side of the Los Angeles Basin does not represent the shoreline but some point far removed from it, the distance depending on the slope of the sea floor at that time.

The information available suggests that an older eroded surface was lowered several thousand feet into the sea, about upper Mohnian or early Delmontian time (upper Miocene), and that the subsequent Repetto sediments filled in on contour around the old eroded surface, with no contemporary deposition on the sides of the basin. At Santa Fe Springs there is a complete Repetto section, but toward the southeast the lower beds progressively buttress out against the older complex, with the younger beds being the most extensive.

Submarine Geology Off Southern California

KENNETH O. EMERY, University of Southern California, Los Angeles.

THE sea floor off southern California consists of a checkerboard-like series of basins separated by submerged or partially submerged mountains. More than 6,000 ft. of relief is present. The basins and banks are bordered by straight steep slopes which have physiographic characteristics typical of fault scarps. Epicenters of many earthquakes fall on or near the scarps, thereby supporting the fault interpretation.

Most of the high areas exhibit effects of wave erosion—terraces on islands, and broad flat tops on submarine banks. Rocks collected from the islands and dredged from the banks are of the same general types and ages as those found on the mainland except that phosphorite, presumably a blanketing authigenic deposit, is far more abundant on the sea floor. Sediments of the banks are dominantly of authigenic and organic origin, whereas those on the shelf bordering the mainland consist of sandy and gravelly detritus contributed by the land areas or residual on the wave-cut surfaces. The basins between the banks and islands contain muddy sediments mostly derived from the land also. The broad flat floors of the near-shore basins suggests that these have received greater quantities of sediment than the more irregular offshore basins.

Paleogeologic Setting for Oil Accumulation in California

HAROLD W. HOOTS, consulting geologist, Los Angeles.

KNOWN commercial accumulations of petroleum in California are restricted to beds of Tertiary age and, in a few local areas, to Cretaceous and fractured metamorphic rocks which immediately underlie the Tertiary.

This paper includes a brief review of Tertiary paleogeography, a discussion of those events which have led to the development of favorable traps, and a description of those conditions and features which have influenced the stratigraphic distribution, geographic location, and size of oil accumulations.

Origin and Evolution of the Los Angeles Basin

H. L. DRIVER, Standard Oil Co. of California, Los Angeles.

THE Los Angeles Basin comprises an area of about 1,200 sq. miles. It is bounded on the north by mountains uplifted along east-west-trending faults. Most of the original faulting trends northwest-southeast, resulting in roughly parallel block faults having varied histories of deformation and sedimentation. Paralleling or lying en echelon to these faults are topographic prominences varying from mountains along the easterly border to hills and knolls within the plain area. The knolls within this plain reflect anticlinal structures which are now developed as oil fields. Productive areas also occur along the borders of the basin. Most of the oil deposits are within beds of lower Pliocene and upper Miocene age. Local accumulations also are present in beds of upper Pliocene age, within middle Miocene, and in weathered or fractured schists of the basement complex.

The rocks within the stratigraphic section range in age from Jurassic (?) to Recent. The basement complex consists of various metamorphic and granite rocks. Remnants of Upper Cretaceous sediments rest on these rocks in the Santa Ana Mountain area and vicinity, and in the Santa Monica Mountains. Eocene sediments also are limited to these two areas. Red beds ranging in age from middle Miocene to probable Oligocene inclusive, are rather widespread and were deposited as interfingers with marine sediments. Igneous activity was pronounced in middle Miocene time. Upper Miocene sediments are the most extensive of the marine deposits. Lower Pliocene sediments were deposited in deeper water. Upper Pliocene and lower Pleistocene sediments are rather extensive and were deposited in shallower water and under conditions of marginal oscillations which have resulted in only limited phases of these deposits being present at the edge of the basin. Active orogenic movement took place at middle Pleistocene time and is continuing to the present. Physiographic features of the basin are the result of this post-middle Pleistocene activity.

Historical Mechanics of Clinton Sand Deposition

JAMES F. SWAIN, Huntley & Huntley, Pittsburgh.

THIS paper attempts to reconstruct the broad sedimentary features of early and middle Paleozoic times in eastern United States as a background and then to examine the dependent sedimentary characteristics of the Ohio province of Clinton sand production.

Paleozoic sedimentation in the eastern United States is viewed to be, in the broad sense, an integrated history of a few large rhythmic movements of transgression and regression, geared to the recurrent uplift and degradation of mountain systems along the present Atlantic seaboard (Appalachia). The mechanics of deposition of the Clinton sands of Ohio are considered to be a phenomenon incidental to the great regression of Trenton and Cincinnatian seas compelled by the uplift and outwash of sediments resulting from the Taconic orogeny.

The Clinton sands are thought to be the result of encroachment of evaporite seas upon a desert-like distribution of sorted sand lying on the Queenston westward edge of the preceding continental wedge. The result of quiet transgression is intact burial of the sand over a large area; the Eolean sands being reworked into long, narrow, recurring transgressive strand lines conforming to the topography of the Queenston surface.

Natural gas is associated with these transgressive strand lines. The occurrence of oil is believed to be associated with minor regressions incident to the dominant transgressive mechanism. The patterns of regressive sand bodies appear to be narrow channel shapes with delta-like appendages.

Geology of Basement Complex, Edison Field, California

JOHN H. BEACH, Independent Exploration Co., Bakersfield, Calif.

THE discovery of oil in the metamorphic basement complex in the old Edison oil field has directed the attention of California geologists to this field and to other areas where metamorphic rocks underlie known structural highs.

In June 1945, a well in the extreme northeasterly part of the field was carried into the "schist" 83 ft. and completed in the metamorphics for an initial potential of 528 bbl. per day. To January 1, 1947, 106 wells have been completed in the basement complex with an estimated productive capacity of 41,300 bbl. per day. Production from the basement zone has extended over 1,600 acres and includes most of the area that produced from the sediments.

The ability of a basement well to produce oil is governed by the amount of communicable voids present in the fractured metamorphics in a favorable structural position on the Edison uplift. The penetrations into the basement vary from 20 to 1,435 ft. with a maximum of 1,350 ft. of oil zone.

Structurally, the Edison oil field is a tilted fault block with abrupt basement escarpments present on the east and north. The regional dip is to the southwest. Faults contribute to the closure in the sediments although the primary cause for accumulation seems to be the thinning and overlapping of sands upon the uplifted fault

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blocks. The source of the oil found in the basement rocks is believed to be the organic marine shales which abut the basement on the north and west.

Relation of Clay Mineralogy To the Origin and Recovery Of Petroleum

RALPH E. GRIM, State Geological Survey, Urbana, Ill.

THE clay-mineral concept of the nature of clays and shales is briefly discussed in its relation to problems of the origin and recovery of oil and gas.

The character of the clay minerals that make up a sediment are to a considerable degree the result of diagenetic changes in the environment of accumulation. Diagenetic changes suggested by present available data are considered.

The relation of various clay minerals to organic material in argillaceous sediments is discussed in the light of evidence which suggests that certain clay minerals under certain conditions are the key factor in the transition of organic matter to petroleum.

The properties of clay minerals are considered as a basis for analyzing the effect of water with dissolved electrolytes moving through a sand on any clay in the sand. The characteristics of the clay minerals are believed to be significant factors in the recovery of oil.

Other significant effects of the properties of the various clay minerals are discussed.

Exploratory Drilling in 1946

F. H. LAHEE, Sun Oil Co., Dallas.

THE report on exploratory drilling in 1946 will present the usual body of statistics for comparison with those of past years. At present writing it is impossible to summarize these statistics for an abstract since not all the data have been received by the writer.

Two general facts may be emphasized here, however. First the classification used by the committee in collecting the data is not as complicated as some people imagine. If clearly understood, it is simple. This we shall attempt to explain. Second, this system of classification and nomenclature more and more is being adopted by individual companies in studying the results of their own exploratory programs. This should be very interesting to us geologists for it reveals a growing consciousness, among executives, of the importance of an annual appraisal of the exploratory effort. And furthermore, the individual company picture may be measured against the average of the country, or the average of the particular state or district where the main operations of the company are located.

The committee on statistics of exploratory drilling has functioned well and faithfully during the past year. Its many members and helpers deserve high commendation for their labors.

Thrust Faulting in the Ventura Basin, California

EDWARD C. H. LAMMERS, Standard Oil Co. of California, Los Angeles.

THE thrust faults of the Ventura basin have been studied in extreme detail because they are intimately related to some of the larger producing oil fields in the district. The faults discussed—the San Cayetano, Oak Ridge, Santa Susana, and Del Valle thrusts—have to date been penetrated by over 100 exploratory and development wells.

Genetically, the thrusts are related to the development of the deep Santa Clara depositional trough in the northern part of the Ventura basin. The Oak Ridge and San Cayetano thrusts, which border the deeper portion of the Santa Clara trough, dip away from the trough beneath the adjacent uplifts. In contrast, the Del Valle and Santa Susana thrusts that border the shallower part of the trough, dip into the trough. Along these faults sediments of the trough have been thrust outward toward the bordering uplifts. The Oak Ridge and San Cayetano thrusts are classified as geanticlinal thrust faults, whereas the Del Valle and Santa Susana thrusts are classified as geosynclinal thrust faults.

Montana and Wyoming Examples Of Overthrusting in Relation to Petroleum Accumulation

D. L. BLACKSTONE, JR., University of Wyoming, Laramie.

SEVERAL occurrences of overthrusting in the Rocky region of Montana and Wyoming and their relationships to oil accumulation are presented by maps and cross-sections. High angle reverse and low angle thrusts are considered. Structural lineaments that may control the location of overthrusting are pointed out. The localization of major Laramide structural features by structural trends in the pre-Cambrian is suggested. The possibility of petroleum accumulation beneath overthrust sheets is stressed. Strata ranging in age from pre-Cambrian to Eocene are involved in the thrusting discussed.

Overthrust Structures of the Alberta Foothills, Canada

THEODORE A. LINK, chief geologist, Imperial Oil Co., Ltd., Toronto.

THE Turner Valley structure is an example of oil and gas accumulation within the porous Paleozoic limestone on the upthrown or overriding mass of a thrust sheet in the foothills of Alberta. Apparently the accumulation of oil and gas, and its segregation from the water, took place before the development of the major or primary faulting. The Highwood uplift, lying directly behind or west of Turner Valley, is a larger structural unit, rises much higher structurally, contains only small amounts of oil and gas, and is primarily water bearing. The Turner Valley structure is partially overridden by the Highwood sheet, and in that respect might be regarded as an example of oil and gas accumulation in a downthrown mass or sheet. However, the water-bearing Paleozoic horizon of the Highwood sheet does not overlap the corresponding oil-and-gas-bearing portion of the Turner Valley sheet.

The Jumping Pound structure, (lying about 20 miles to the northwest of Turner Valley), is an example of gas and distillate accumulation in the downthrown or overridden mass of a thrust sheet wherein the surface overthrust sheet did not involve the producing Paleozoic limestone mass.

The Wildcat Hills, Stolberg, and Coalspur structures, are also examples of surface overthrus sheets or masses which did not involve the Paleozoic limestone, but which were drilled deep enough to encounter the prospective oil and gas horizons within the Paleozoic on the downthrown side of the major sole fault or faults, but which proved to be nonproductive of oil and/or gas. The Paleozoic limestone in the Wildcat Hills test was porous but contained sulfur water, while in the Stolberg and Coalspur tests the prospective Paleozoic horizon lacked porosity.

The Brazeau structure is a large, complicated structural uplift as observed at the surface, (similar to the Highwood uplift) which, as the result of deep drilling, proved to be severely faulted, thus placing the prospective Paleozoic limestone at considerable depth below at least one major sole fault. The limestone proved to be very low in porosity and permeability and only a small show of gas and distillate resulted after a thorough test.

The "Muskeg structure," (the most northerly test in the foothills belt), is a well-defined surface anticline suspected of being another overthrust sheet in which it is hoped the prospective Paleozoic limestone may be involved. Due to extremely high exploration and drilling costs, the recent trend has been to test foothills structures jointly wherein two to five companies share costs and participation.

Exploration and Evaluation Of Petroleum Possibilities in Southwestern Alaska

LEWIS B. KELLUM, University of Michigan, Ann Arbor.

THE geologic province in southwestern Alaska affording the greatest promise of commercial oil production is a belt of Jurassic strata extending along the west side of Cook Inlet and the Shelikof Straits for 250 miles. It attains a maximum width of about 40 miles in the vicinity of Mount Katmai and is bordered on the northwest and southeast by metamorphic rocks, probably of Paleozoic age, which are intruded by granite batholiths considered to be of early Jurassic age. The exposed section of near-shore clastic sediments has a thickness of nearly 21,000 ft. and includes highly fossiliferous strata of Lower, Middle and Upper Jurassic age. Study of the faunas has yielded a sequence of faunal zones well correlated with those of Canada and the western United States. Faunal studies have played an important role in this investigation.

Evaluation of oil possibilities is based on analysis of the following factors:

1. The exposed sections of Triassic and Jurassic strata.
2. The sections penetrated by deep wells drilled in the province.
3. The regional structural setting.
4. Local structures.
5. Oil seepages.
6. Igneous activity.

Paleogeographies of South America

L. G. WEEKS, Standard Oil Co. of N. J., New York.

THE major features of the geologic framework of the continent are outlined. Attention is called throughout the paper to the many similarities in the continental framework and geologic history of South America to those of North America.

The change in paleogeographies and facies from Cambrian to Pliocene inclusive is pictured on 15 paleogeographic facies maps selected to show the principal sedimentary overlaps. Intervening changes and conditions, the progress of transgressions, and the fundamental transitions in the architecture of the continent that caused or conditioned the paleogeographic and facies changes are briefly reviewed.

Petroleum Geology of Eastern Peru and Ecuador

BERNHARD KUMMEL, Columbia University, New York.

THE geology of this vast region is known principally from reconnaissance reports by Singewald, Chase, Oppenheim, Maura, and Wanderlay; Moran and Fyfe,

and Tschopp. The author has recently spent 3 years working in eastern Peru for the Peruvian Government and has gathered new data on the area.

The only production now being obtained from this area is at the Ganza Azul field on the Pachitea River. Exploratory drilling is now under way in various places in both Peru and Ecuador. The stratigraphic section in this area includes thousands of feet of rocks representing Ordovician, Pennsylvanian, Permian, Triassic, Jurassic, Cretaceous, and Tertiary ages. The present status of our geological knowledge of this important region is reviewed.

Central America as a Petroliferous Province

W. P. WOODRING, U. S. Geological Survey, Washington.

MUCH of Central America is covered with igneous rocks. They consist of the volcanic and intrusive basement, on which the marine formations lie, and later volcanics.

Except in the northern part, the marine formations are of Tertiary age, and are found in relatively small basins. More extensive basins may, however, be covered by an unknown thickness of late Tertiary and Quaternary volcanics. Further exploration and testing of the larger known Tertiary basins, and geophysical prospecting of lava-covered inferred basins are justified.

The thick marine Lower and Upper Cretaceous section of northern Central America and adjoining southeastern Mexico includes adequate source rocks and reservoirs. It offers the most promise.

Genesis and Evolution Through The Tertiary of the Interior Valley Basin of California

GLENN C. FERGUSON, consulting geologist, Bakersfield, Calif.

THE inception and geological history of the Great Valley of California is allied closely with the diastrophism of the Sierra Nevadas and Coast ranges. As a result, therefore, this great basin has been subjected intermittently to a deluge of sediment since early Cretaceous. Evidence for the inception and continued development as a basin, employing isopach and stratigraphic data, is briefly reviewed.

Oil and Gas Prospects of Washington and Oregon

HAMPTON SMITH, consulting geologist, Los Angeles.

AFTER many years of nearly complete quiescence, scientific prospecting for oil and gas in Washington and Oregon entered a period of accelerated activity during the war, which activity will probably continue for at least another 2 or 3 years.

The area of interest included several noncontiguous districts in a region 400 miles long and 100 miles wide. A number of operators have carried out extensive projects of surface mapping and seismograph work in one or more of these districts and 8 or 10 wildcat wells have been drilled or are drilling. A thumb-nail geological sketch of the areas around the wildcat wells is presented and an attempt is made to reevaluate these areas. The geology of several other prospective districts is outlined and the rapid change in facies in some groups of sediments and the resultant lack of any close relationship between prospects in different districts is discussed.

The Stratigraphic Sequence In the Philippines

ROBERT M. KLEINPELL, University of California, Berkeley.

FOR all its local complexities, the Philippine archipelago represents in the main a northward extension of the folded deposits of that Cenozoic geosyncline which passes from the Himalayas southward through Burma, eastward through the southern Greater and Lesser Sundas and on around the Banda Arc, northwestward and then northward, through the region of Macassar Strait eventually to Formosa and Japan.

Within the Philippine portion of this geosyncline, Hollister has been able to recognize more than one distinct tectonic province. Volcanism has been pronounced, noticeably during the late middle and upper Eocene but particularly so from the Miocene onward and mainly in the eastern portion of the archipelago. The Philippine Cenozoic strata, faunally as well as lithologically, represent a continuation of the Netherlands East Indies Cenozoic. The "letter classification," worked out by Leupold and van der Vlerk for the Tertiary of the N.E.I., is equally adapted to the Philippine Tertiary sequence. Above the more or less folded Tertiary and earliest Quaternary occurs the later Pleistocene-Holocene sequence, largely pyroclastic and lacustrine, with elephant and rhinoceros remains and an extensive sequence of human artifacts.

Petroleum exploration with the drill, interrupted by the Japanese invasion, has recently been resumed in the Philippines under the supervision of Corby. A summary of such stratigraphic data as have been salvaged from the wreckage of war is being prepared for publication by the speaker.

Geologic Framework of the Pacific Region

WALTER H. BUCHER, Columbia University, New York.

THE structural framework of the Pacific Ocean comprises the Cordilleran belt in the Americas and the broad zone that lies in the north between the island arcs and their counterparts on the Asiatic continent and in the south between the "andesite line" and the Australian and Antarctic continents. It owes its unique significance to the nature of the segment of the earth's surface it surrounds: a vast area of sima without a trace of sial, magmatically uniform in the excess of soda over calcium, and differing in this respect sharply from the corresponding rocks of the frame. The nature of this contrast constitutes the first major problem of the region. Because of its far-reaching importance, Rittman's hypothesis will be briefly mentioned.

The shape of the frame as seen in ground plan raises problems of equal importance. It is angular in large outline as well as in major detail, with parallelisms as striking as those of the Atlantic Ocean. Stille's analysis of over-all shape will be followed by a brief reference to one of the writer's earlier experiments that is believed to shed light on the major details of the border. The width of the structural frame of the Pacific is much greater on the west than on the east side due to the intercalation of a zone of marginal seas, from the Bering Sea in the north to the Tasman Sea in the south. There is a close relation between these marginal sea basins and the island arcs, (especially also their tendency to en echelon pattern of their major topographic axes), deep-sea trenches, asymmetric tilting of terraces and reefs, "Meineszlines'" of negative gravity anomalies, and zones of deep-seated earthquakes. This points to a late origin of the marginal sea basins and active orogeny along their borders today. Suggestive evidence concerning the age of the basins will be quoted.

Folding dominates the framework everywhere, in well-known contrast to the other oceans. The nature of the mobility, whether "homogeneous" or "heterogeneous," is analyzed as well as the incidence in time of the latest "master-epoch" of folding along the better-known portions of the framework.

Geologic Development of The Ventura Basin and Its Petroleum Deposits

THOMAS L. BAILEY, consulting geologist, Ventura, Calif.

THE east-west trending Ventura basin of southern Santa Barbara, Ventura, and eastern Los Angeles counties is one of the four important oil-producing basins of California. It is 120 miles long and 20 to 40 miles wide, and lies between the Santa Ynez-Topatopa Mountains on the north and the Santa Monica Mountains-Channel Islands on the south.

The present axis of the basin approximately follows the Santa Clara River from its headwaters to its mouth near Ventura. Most of the western half of the basin, between Ventura and Pt. Concepcion lies beneath the waters of Santa Barbara Channel. The basin began to form in upper Cretaceous time and over 40,000 ft. of upper Cretaceous, Tertiary, and Quaternary sediments have been deposited on a basement composed of Jurassic and earlier plutonic igneous rocks and more or less metamorphosed sedimentary rocks.

Core Orientation by Graphical And Mathematical Methods

HUGH McCLELLAN, Continental Oil Co., Los Angeles.

THIS paper reviews mathematical, graphical, and mechanical methods, (including Curtis H. Johnson's method based on the analogy to the problem of two tilts), for correcting the apparent dips in oriented cores for the effect of the angle of deflection of the bore hole. In addition, the common case is treated in which the core is not oriented but instead a regional or local strike is assumed. By means of examples, this solution and previously published solutions for the case of an oriented core, are reduced to a step-by-step routine with convenient charts and formulas serving as double checks upon each other. It is pointed out that in the case of an unoriented core, when the strike is assumed, there are usually two possible values for the true dip, one of which must be selected on the basis of geological probability.

Geology and Occurrence of Oil in Florida

E. D. PRESSLER, Humble Oil & Refining Co., Tampa.

THE eastern portion of the Gulf of Mexico can be divided into the North and South Florida Provinces on the basis of stratigraphy, and subdivided further on the basis of its major structural features. The southeast striking ridge formed by the Central Georgia, Ocala, and Bahama Uplifts is considered to represent the marginal flexure of this portion of the Gulf Basin. The Apalachicola embayment of south Georgia and west Florida has a maximum sedimentary fill of approximately 15,000 ft.

of clastic sediments, and the South Florida embayment, which covers the area of South Florida, the Bahamas, Cuba, and the intervening areas, has a maximum fill of nonclastic sediments approaching 20,000 ft., and the area of the Great Bahama Bank is considered to be underlain by a section in excess of 10,000 ft. Anticlines are the most prevalent type of structure of both embayments though faulting may be present, and conditions are favorable for the formation of stratigraphic traps. Oil production has been developed on the south Florida segment of the embayment, and additional drilling development is under way. Gravity and core drill are the most widely used methods of prospecting, and additional experimental work is necessary to develop proper seismograph technique. The Sunniland field of Collier County, Florida, has four producing wells now that have produced a total of approximately 100,000 bbl. of 19° to 24.5°-gravity oil. One rig is working in the field, and seven wildcat operations are active in Florida.

TXL Field, Ector County, Texas

C. D. CANTRELL, JR., Phillips Petroleum Co., Midland, Tex.

THE TXL field, western Ector County, Texas, ranks among the most important in the Permian basin, although not yet defined. Discovery was made by Shell Oil Co., Inc., and Cities Service Co. using subsurface and seismic work, April 12, 1944. By the end of 1946, the producing area was 6,300 acres, and the field had produced 3,310,000 bbl. of oil from 86 Devonian wells, and 2,590,000 bbl. from 72 Ellenburger wells. Four other oil-bearing formations are practically undeveloped.

The stratigraphic section begins in Cretaceous surface rocks and ends in granite underlying the Ellenburger dolomite of Ordovician age. Major folding, some faulting, and truncation occurred during Pennsylvanian time. Permian beds now lie on rocks from Pennsylvanian to Silurian age. Mild folding continued during Permian time, with pre-Permian and Permian structural axes nearly coincident.

Commercially, the Ellenburger dolomite, at a depth of about 9,600 ft., is most important. Oil accumulation is in a north-south anticline, faulted along the east side. The pore spaces are druses and fractures lined with secondary calcite and dolomite crystals, resulting in high permeability and well capacity. Reservoir liquid is undersaturated some 1,300 psi., thus there is no gas cap. The producing force is a water drive which is maintaining the reservoir pressure. Oil averages 43° gravity and is of superior quality for refining. Source of the oil is thought to be the overlying Simpson shales.

Geology of West Tepetate Oil Field, Jefferson Davis Parish, Louisiana

FRED W. BATES and JAY B. WHARTON, JR., consulting geologists, Lafayette, La.

THE West Tepetate oil field, located in the Louisiana Gulf Coast area, was discovered by Barnsdall Oil Co. and Vincent & Welch in 1944. The presence of the structure was first suggested in 1930 by torsion-balance exploration conducted by Vincent & Welch and was subsequently disclosed by various seismograph surveys during 1941 to 1944. The producing section lies below the Heterostegina zone in the middle Miocene, and consists of nine oil and gas-bearing sands ranging from 7,600 to 9,500 ft. in depth. The structure is a gentle seated intrusion of salt, though none has been encountered to date. There is about 100 ft. of effective closure at the producing levels. Only one fault has been proven, though a major regional fault, downthrown to the south, is indicated by seismograph to the north of the field, probably being a westward extension of the similarly bounding fault in the Tepetate field. The productive limits thus far established enclose some 1,400 acres, offering a reserve of between 30 and 40 million barrels of liquid hydrocarbons.

A Geological Sketch of the Japanese Islands

CHARLES W. CHESTERMAN, San Francisco.

THE Japanese Islands, consisting essentially of Hokkaido, Honshu, Shikoku, and Kyushu, lie off the eastern coast of the Asiatic continent. From a geological viewpoint these islands are simply summits of a great mountain range that was separated from the Asiatic continent by depression of the intervening seas. The country is practically devoid of extensive plains and, for the most part, is quite mountainous.

Structurally, the Japanese Islands are divided by the Median Line into two parallel zones which curve toward the northwest. The zone on the Pacific, or convex side, is referred to as the "Outer Zone," while that zone which lies on the concave side is called the "Inner Zone." Rocks ranging from pre-Carboniferous to Cenozoic the better developed and more regularly arranged in the Outer Zone than in the Inner Zone where structures are more complicated.

Contrary to the popular belief that the Japanese Islands are wholly underlain by volcanic rocks, there are exposed on the islands, sedimentary, metamorphic, and igneous rocks ranging in age from middle Paleozoic to Recent.

The Cumberland Oil Field, Bryan and Marshall Counties, Oklahoma

IRA H. CRAM, Pure Oil Co., Chicago.

THE Cumberland oil field, located in southern Oklahoma 12 miles east of Madill and 24 miles north of Denison, Tex., was discovered in March 1940. Since that time, 151 oil wells have been completed in the field at depths between 5,050 and 6,550 ft. Accumulated production as of December 1, 1946, was approximately 21,500,000 bbl.

The structure is a slightly asymmetrical closed anticline, the southern portion of which is cut by several minor normal faults. The anticline was nicely outlined prior to drilling by a reflection seismograph survey following surface, subsurface and magnetic surveys. The axis of the structure trends northwest-southeast paralleling the Tishomingo anticline of the Arbuckle Mountains. A narrow syncline and major faults separate the anticline from the mountain system. Pennsylvanian and older rocks are involved in the folding and faulting, but only a slightly irregular south dip is revealed by mapping the exposed Comanchean beds.

The sections of Pennsylvanian, Mississippian, Devonian, Silurian, and Ordovician rocks found in drilling are closely similar in all respects to sections of the same rocks exposed in the southeastern Arbuckle Mountains. All oil production comes from sands in the Simpson group of Ordovician age, the basal Bromide, basal McLish and basal Oil Creek sands being the main producing horizons.

The stratigraphy, structure, and exploratory work leading to discovery are stressed in the presentation.

DIGESTS OF S.E.G. PAPERS

Practical Consideration for Electrical Prospecting

WM. BRADLEY LEWIS, The Elflex Co., Houston.

THE possibility of detecting oil directly through its electrical resistivity presents an incentive for investigating electrical methods that show evidence of sufficient working depths. By the use of low-frequency commutated currents, effects are obtained from several thousand feet below the surface. Experimental evidence of working depths is presented.

A Total Field Magnetometer For Mobile Operation

EUGENE FROWE, Robert H. Ray & Co., Houston.

A magnetometer which measures the earth's total magnetic field is described. The detector or measuring element of the magnetometer contains three mutually perpendicular elements, two of which are utilized to orient the third, which in turn operates a recording apparatus to record the total magnetic field. The detector elements are of the inductive type and do not require ferromagnetic material to give them the high sensitivity required in geophysical work.

The presence of a magnetic field in the region of the detector causes alternating currents to be generated in the detector elements. These currents are amplified to actuate thyratron tubes, which control the orienting and neutralizing functions of the magnetometer. A tape recorder gives continuous field readings. The accuracy of the magnetic data taken is better than 10 gammas.

Preliminary Results of a Study of Seismograph Sensitivity Requirements

P. E. HAGGERTY and R. W. OLSON, Geophysical Service Inc., Dallas.

THE sensitivity of a seismograph system need be no greater than such as to raise the lowest expected ground-disturbance level to a reasonable fraction of full-scale deflection. This paper draws preliminary conclusions from data on ground disturbance level as related to wind, temperature, and other factors in an effort to determine the minimum ground-disturbance level which may be expected for any appreciable period of time.

History of Explosives Present Relation to Seismograph Work

R. W. CRABTREE, Hercules Powder Co., San Francisco.

THE discussion presented in this paper may be summarized under the following five headings:

1. A brief discussion of the history of

explosives with particular reference to the difficulties involved in the development of a seismic explosive capable of meeting the extremely varied requirements of reflection shooting.

2. Deep shot-hole shooting. Effect of pressure on general characteristics of a seismic powder and possible changes in rate of detonation and sensitivity. Use of strong electric caps in deep-hole shooting.

3. Effect of changes in rates of detonation to obtain better reflections in so-called "dead" areas. Size of charges.

4. Vibrations and possible effect on water wells and oil wells.

5. Directed energy. A brief discussion on the shaped charge and its possible use in the seismograph field.

Winter Operation of Geophysical Equipment in The Rocky Mountain Area

HARRY L. THOMSEN and GERALD A. BURTON, Shell Oil Co., Inc., Casper, Wyo.

A LARGE increase in geophysical activity in the Rocky Mountain area has occurred during the last few years. In the past, most of the activity has been seasonal because of adverse weather conditions during the winter months. However, growing competition has resulted in a tendency for geophysical crews to carry on operations throughout the winter. The authors review the performance of several crews which have had experience in winter work, summarize problems connected with winter operations, and discuss methods which have been developed to improve efficiency under these conditions.

Gravitational Terrain Effects of Two-Dimensional Topographic Features

M. KING HUBBERT, Shell Oil Co., Inc., Houston.

IF terrain corrections are not systematically made when conducting gravity surveys, it is a matter of some importance to locate stations away from points for which this effect is a maximum. While this fact is fully appreciated, our literature is deficient in information that a field man could use telling him how large would be the effect of a given topographic feature, or how far away the station should be placed to keep the error within prescribed limits.

To meet this need continuous profiles of terrain effects across 47 different forms of two-dimensional topography have been computed and are presented. These are expressed dimensionally so that each figure represents an infinite class of features having the same shape. In addition, the profile for each plotted ridge is also valid for valleys of the same form, but inverted. The data thus are applicable to a double infinity of cases.

These profiles are also useful to the interpretative staff for determining quickly whether certain small anomalies are significant, or whether they are more probably the result of local uncorrected terrain.

Applications of Shoran and Photographic Techniques to Aerial Magnetic Surveys

J. M. KLAASSE, L. H. RUMBAUGH, and H. JENSEN, Naval Ordnance Laboratory.

AIRBORNE magnetic surveying poses three problems: (1) Obtaining and recording accurate magnetic data; (2) correlating these data with the position of the surveying airplane, and (3) eliminating or compensating for the effects of magnetometer drift and time variations in the earth's magnetic field.

First, a grid or network of systematic flight lines is laid out to cover the area to be surveyed. A continuous record of the total magnetic field is obtained along each flight line by means of the AN/ASQ-3A magnetometer modified for geophysical work. Position over variable terrain is determined by direct visual contact, using accurate maps if available, or trimetrogon photographs if the area is poorly charted or uncharted; in either case, position is recorded and correlated with magnetic data through the use of a modified Sonne strip camera and a system of coordinated relay-operated number counters.

Position over featureless terrain or extensive water bodies is determined with Shoran (AN/APN-3). Aircraft Shoran position is obtained and correlated with magnetic data by number counters and a recorder operated semiautomatically from the Shoran set. Effects of magnetometer drift and time variations in the earth's magnetic field are minimized by the choice and arrangement of flight lines. Time variations in the earth's field are recorded by a ground station. Flights are suspended during intense magnetic disturbances. About 100,000 square miles have been surveyed by these techniques. Airborne magnetic surveys in Naval Petroleum Reserve No. 4 in northern Alaska and in the tidelands of Louisiana and Texas are discussed, the first to illustrate position control by photographic methods, and the second to illustrate the use of Shoran, as applied in joint undertakings by the Naval Ordnance Laboratory, the Naval Petroleum Reserves, and the U. S. Geological Survey.

Geophysical History of The Ten Section Field, Kern County, California

JOSEPH C. WATERMAN, Shell Oil Co., Inc., Bakersfield, Calif.

THE Ten Section oil field, generally regarded as the first geophysical oil-field discovery in the San Joaquin Valley of California, was found by Shell Oil Co., Inc., by means of a reflection seismograph survey made in 1934-1935. The discovery well, Shell K.C.L.-Stevens A-1, was completed in June 1936. A map presenting results of reflection shooting before discovery and one from well data with contours on the top of the productive upper Miocene "Stevens" sand are shown.

Offshore Surveying With Radar

G. R. JOHNSON, Radar Exploration Co., Toronto.

A METHOD of using radar for offshore surveying is outlined. The limitations of range are discussed by developing the fundamental radar equation as modified by the curved reflecting surface of the sea. Certain conclusions are reached as to the most suitable type of equipment for offshore work. A short analysis is made of the errors involved in the radar system with examples of how they are determined by comparison with chained distances.

Airborne-Magnetometer Operations

R. D. WYCKOFF, Gulf Research & Development Co.

AIRBORNE magnetometer operations involve two basic problems: (1) Measurement of the magnetic field intensity, and (2) navigation of the aircraft to provide the desired profile configuration and accurate mapping of the profiles flown. Currently the navigation and mapping present the most serious problem if the operation is to be made completely airborne. A brief outline of the magnetometer instrumentation is presented, together with a discussion of the mapping problem. Examples of results are presented.

Geochemical History of the Hardy Field, Jones County, Texas

W. R. RANSOME, Geochemical Surveys, Dallas.

THE Hardy field was discovered in November 1943 as a result of a geochemical survey of a portion of Jones County, Texas. This survey was commenced in August 1942. The discovery well opened a new Canyon Sand pay zone and development of the field has shown that this sand pinches out across a nose forming a typical stratigraphic reservoir. The lack of other corroborating evidence, such as subsurface control, makes the exploration history of the Hardy field unusual.

Geophysical History of Raisin City Field, California

JOHN SLOAT, Union Oil Co. of California, Bakersfield, Calif.

THE discovery history of Raisin City field is presented because it demonstrates the ability of seismograph to locate low relief structures, where closure is present only in certain zones, even in areas where records are of mediocre quality. The seismic map which led to leasing is shown, along with detail maps made several years later. Gravimeter maps and maps from well points are also presented.

Geophysical History of Canal Oil Field, Kern County, California

R. W. SHOEMAKER, The Ohio Oil Co., Bakersfield, Calif.

THE discovery well of Canal oil field was located with the help of dip reflection seismograph work. Three separate surveys were made before discovery of the field in 1937. Only the last of these surveys indicated structural closure. After discovery of the field, an additional survey was made to obtain information on which to base a field development program.

The Committee on Geophysical Sciences of the Joint Research And Development Board

ROLAND F. BEERS, The Geotechnical Corp., Dallas.

THE committee on geophysical sciences of the joint research and development board (Army and Navy) has been organized as an agency of the board, in order that the charter of the board may be implemented in the field of geophysical sciences. The fundamental purpose of the committee comprises the continuing study, evaluation, improvement, and allocation of research and development plans and progress in the field of geophysical sciences in relation to the over-all aims of the national-defense effort, and to the available and potential store of scientific information, personnel, and facilities leading to the formulation of an integrated program in this field.

The committee consists of four civilian members, including the chairman, appointed by the chairman of the joint research and development board; two members ap-

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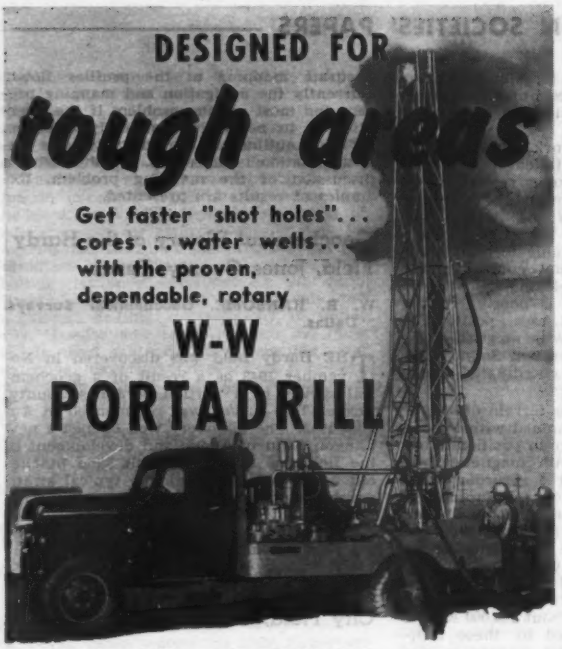

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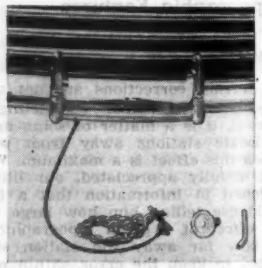

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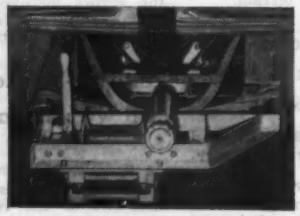

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pointed by the secretary of war, and two members appointed by the secretary of Navy.

The subject matter for which the committee is responsible includes:

Physics of the upper atmosphere; atmospheric electricity; cartography and geodesy; geology and mineral raw materials; terrestrial magnetism and electricity; hydrology; meteorology; oceanography; seismology, soil mechanics and volcanology; geophysical instrumentation and engineering.

As an agency of the joint research and development board the committee will not attempt to control the administration of research and development activities of joint interest to the War and Navy departments, but will leave such administration to agencies within the departments charged with such responsibilities by law or intra-departmental directive. The joint research and development board operates within its jurisdiction as an agency of the secretaries of War and Navy.

Case History of the Fort Collins Extension, Larimer County, Colorado

JOHN H. WILSON, Independent Exploration Co., Fort Worth.

THE results of a gravity-meter survey of the Fort Collins field, Larimer County, Colorado, both before and after elimination of regional effects, is presented, together with subsequent seismograph and subsurface studies which led to the development of a small northward extension of the Fort Collins oil field. Other geophysical work in the area is reviewed.

Magnetic Surveys From a Helicopter

HANS LUNDBERG, Hans Lundberg, Ltd.

THE paper contains a brief account of a series of experimental flights with a magnetometer mounted in a Bell helicopter. Emphasis has been placed on the amount of detail obtainable and comparison is made between surveys on the ground and the same area flown at 100 to 150 ft. Some details as to the construction of the instrument are given and data of the effectiveness of the helicopter-borne magnetometer.

Aeromagnetic Exploration

C. A. HEILAND, Heiland Research Corp., Denver.

THE beginning of aeromagnetic observations may be traced back to the early balloon ascents. Their application to geophysical prospecting followed more than 100 years later. In its present form, aeromagnetic technique is largely the result of wartime developments in submarine detection. The various approaches to the problem along the line of instrumentation have made use of coupled magnetic systems, stationary or rotating coils, magnetrons, and saturable reactors. The latter has been most successful and was used during the war in aircraft compasses, degaussing equipment, mine fuses, and submarine detectors. In the M.A.D. devices, saturable reactors served the twofold purpose of field detector and orienter. Although submarine-detection equipment may be modified for prospecting applications, it appeared preferable to develop equipment especially for this purpose. Since one of the principal problems in aeromagnetic exploration is position fixing irrespective of the possibility of taking terrain photographs, the objective of the design was a recording method permitting of synchronizing magnetic readings with position fixes. An automatically tracking U.H.F. system indicates distances from two reference positions on the ground at discrete time intervals. Together with the magnetic readings, barometric and radio altitude, time, record number, magnetic range and gyro attitude, the position fix appears on a panel which is photographed by a camera which also records a terrain photograph when conditions permit. By comparison with wartime models, the size of the detector has been reduced; it is mounted at the tip of a wing and compensated for so-called maneuver noise; that is, effects resulting from permanent, induced, and eddy-current fields which change with the pitch, roll, and course of the ship. By comparison with ground surveys, aeromagnetic exploration offers many advantages, such as rapidity of observation, ability to survey inaccessible areas, and attenuation of topographic and man-made effects. Depth calculations are facilitated when traverses are repeated at several different elevations.

Recent Techniques and Projects For the Airborne Magnetometer

HOMER JENSEN, Aero Service Corp.

AIRBORNE-MAGNETOMETER surveys have been made since 1943 under the auspices of the various governmental departments, and using converted wartime submarine-detection instruments. During 1946 intensive preparations were made to develop new instruments and to use them in commercial surveys. Gulf Research and Development Corp. conducted successful flights, and in January 1947, Aero Service Corp., using the Gulf magnetometer, started the first contract survey with this new device. Advantage has been taken of the intensive engineering and the great backlog of practical experience associated with the governmental surveys. The detector remains at the end of a cable outside of the aircraft to minimize the effects of stray fields, and the correlation techniques through continuous strip photographs and Shoran guides continue along lines developed in the earlier surveys. In general, records are made continuously where possible, with intermittent fiducial marks established for correlation of the various continuous records of ground track, altitude, and magnetic intensity. A great survey will be started early in 1947 of the whole Bahamas area. Shoran will be used not only to guide the aircraft, but to provide an intensive net of low-order triangulation over the whole area to relate positions of the Shoran stations. Segments of the survey patterns will be similar, permitting the use of standard printed forms for presentation of the data currently with the progress of the survey.

It Is Earlier Than You Think

FRANK RIEBER, Rieber Research Laboratory.

IT is shown that the art of seismic exploration has now reached a critical point, similar to the stage in the X-ray art which brought forth the Coolidge tube, or the stage in the art of radio communications which brought forth the three-electrode vacuum tube and made possible the almost incalculable series of advances which began with the wireless telephone and have culminated with radar. Predictions are made as to the nature and scope of the advances which we may shortly expect in the seismic method. It is suggested that the impact of these new techniques on exploration problems should create an "internal frontier," comparable to the external frontier now offered by the continental shelf. Suggestions are made for cooperation among company management, geologists, geophysicists, and instrument engineers, to expedite the availability of the new techniques.

Use of a Water-Coupled Microphone System for Seismic Surveying

B. L. SNAVELY, R. BERESFORD, H. N. CLARKSON, K. W. ERICKSON, GALE WHITE, and J. V. ATANASOFF, Naval Ordnance Laboratory, Washington.

THE use of pressure-sensitive microphones in place of inertial geophones for underwater seismic prospecting is made possible by the direct relation between ground motion and corresponding variation in water pressure. The Naval Ordnance Laboratory's Mk 1 Acoustic System features a sensitive, low-impedance hydrophone responsive to frequencies from zero to 300 cycles per second, and consists in principle of an inductance whose variation with pressure produces linear unbalance of a 1,000 cp. a.c. bridge. The sensitivity of this instrument is comparable to that of a standard geophone, and it may be simply calibrated in absolute units.

This system has been successfully used in seismic investigations in the Caribbean and in the shallow water off the United States East Coast during the war. It was also used in the refraction survey which investigated the subsurface structure of Bikini atoll at the time of the atomic bomb tests there.

Associated equipment necessary to the collection of data for an underwater survey include:

1. Recording instruments.
2. Communicating facilities, such as radio, to coordinate recording and shooting parties and to transmit shot moments.
3. Shot-point and hydrophone locating techniques of necessary accuracy.
4. Facilities for laying and retrieving hydrophones and cable.
5. Facilities for handling and detonating underwater explosives. The Bikini survey is cited to illustrate the function of these essential elements, and to suggest some practicable variations.

Performance of the Mk 1 system indicates its possible utilization in both refraction and reflection underwater seismic investigations.

A Vehicle Borne Instrument For Continuously Indicating Road Elevations

D. SILVERMAN, J. D. EISLER, and J. F. EVANS, Stanolind Oil & Gas Co., Tulsa.

AN electrochemical device mounted in a moving vehicle capable of indicating differences in elevation between successive points along a traverse is described. Principle of operation, constructional details, and operating techniques are treated at length. Examples of elevation-survey data obtained with the instrument under actual field conditions are presented.

Two Recent Improvements In Radioactivity Prospecting Apparatus

M. J. TEST, Geophysical Instrument Co., Arlington, Va.

DETAILS are given of an "all metal" Geiger-Muller counter tube, with the resulting material in its interior reduced to a minimum. This construction has improved mechanical robustness, at the same time lowering background count by avoid-

ance of spurious charges. Such tubes have been successfully employed in geophysical exploration.

Argon and alcohol vapor filling has enabled production of tubes having cosmic ray efficiencies over 99 per cent, plateaus over 200 volts long and plateau slopes within 0.001 per cent.

A portable radioactivity detector is described, having a weight less than 4½ lb. (including batteries and headphones). This light weight is attained by a compact oscillator circuit supplying the Geiger-Muller voltage from a 135-volt B battery. Filtering and regulation for the high voltage are described. The compactness and ruggedness of the unit adapt it for radioactive mineral prospecting. Mineral samples may have their activity measured in an annular container surrounding the Geiger-Muller tube. Standardization is effected by standard samples incorporating a known quantity of radioactive material.

A Velocity Analysis of the East Coalinga Nose Area of California

G. J. LONG, Standard Oil Co. of Texas, Houston.

THIS paper describes a method which was used to apply a velocity correction to seismic reflection work, located on the east flank of the Coalinga nose in Fresno County, California. Velocity information obtained from two well surveys within the prospect, indicated the presence of lateral variations in vertical velocity of sufficient magnitude to cause errors in depth calculations in excess of 500 ft. at horizons of interest. Velocity determinations were shot using the X^2-T^2 method in order to supplement the well information. Using this information it was possible to construct variable brachistochrones from which each profile was calculated on an individual vertical velocity function. The purpose of the work was to outline the limits of production on an existing field of the stratigraphic type. The results indicated that this was done satisfactorily.

Potentiometric Model Studies

B. D. LEE, The Texas Co., Houston.

A SIMPLIFICATION of the method of Hurst and McCarty for conducting potentiometric model studies is presented along with experimentally determined invasion patterns for certain idealized flow problems. The analytical solution for one class of these problems is given. Finally, a general description is given of a newly developed instrument which permits direct mapping of flow lines and determination of transit times in potentiometric model studies.

New Methods for Interpretation Of Seismic Records From Underwater Explosions

C. L. PEKERIS, Columbia University, New York.

A STUDY of the wave theory of the propagation of explosive sound in shallow water revealed that, in addition to the arrival times of the various refracted waves used in the seismic exploration of the ocean bottoms by the standard refraction method, the pressure wave received at large ranges from the source should exhibit the following features, which are also characteristic of the depth of water and the structure of the bottom:

1. In case of a uniform bottom extending down to a depth many times the depth of water, the ground wave should begin with a so-called limiting period, which is characteristic of the depth of water and the sound velocity in the bottom.

2. The ground wave should be followed by a water wave which is propagated with the speed of sound in water, and which has the form of an oscillation of gradually increasing period. This dispersion in the water wave (the Ewing effect) is such that each period travels with a characteristic velocity. From the observed period-velocity curve one can infer the structure of the top layers of the bottom.

3. The water wave should arrive riding on a low-frequency wave called the rider wave, whose period just prior to the arrival of the water wave is characteristic of the depth of water and the structure of the bottom.

4. The amplitude of the water wave should increase to a maximum and should decrease thereafter, while the period should remain constant after the maximum is passed. The value of this period, called the airy period, is again characteristic of the depth of water and the structure of the bottom.

5. In a layered bottom in which the top layer is only of the order of the depth of water, the secondary arrivals and the rider wave should be relatively weak.

All of the above theoretically predicted new features have been discovered and measured in a study of more than 120 records obtained by Prof. M. Ewing and L. Worzel at five stations on the Eastern Continental Margin. The deductions about the structure of the bottom made from the various features, including the standard refraction data, agree among themselves.

A Shooting Method for Areas Of Difficult Drilling

E. D. ALCOCK and K. H. WATERS, National Geophysical Co., Dallas.

A METHOD of shooting has been described which may be used, in areas where the drilling conditions are difficult, to obtain a relatively large amount of information for each hole drilled. The method approximates to a variant on the reflection velocity profile when dips are small, but new methods of computation have been devised when steep dips are encountered.

Weathered Layer in Water-Covered Areas

FRANK PRESS and MAURICE EWING, Columbia University, New York.

VARIOUS methods of evaluating depth and velocity of a low speed bottom layer in water-covered areas are discussed.

A New Calculation Technique For Quantitative Interpretations In Gravity Prospecting

SIGMUND HAMMER, Gulf Research & Development Co., Pittsburgh.

IN this technique, the densities of the various strata in an assumed geologic structure are considered as unknown and determined by Least Squares to give the best possible fit between the computed and observed gravity effects of the assumed structure. If the computed result does not fit the observed data, it is immediately evident that the assumed structure is incorrect because no trial-and-error manipulation of the density values can improve the fit. If the computed result does fit the observed data, the reasonableness of the computed densities is the principle criterion for judging the geologic reasonableness of the interpreted structure.

The technique has been tested in practice and has been found very useful. It is especially convenient for utilizing gravity data to choose between different structures postulated by equally competent geologists. Examples will be shown.

Seismic Measurement of Distance in Shallow Water

MAURICE EWING and FRANK PRESS, Columbia University, New York.

THE principal factors affecting the speed of sonic signals in shallow water will be discussed.

Geophysical History Block 31 Field Crane County, Texas

LEE B. PARK and ALEXANDER E. McKAY, geophysical section, The Atlantic Refining Co.

THE Block 31 field located on University of Texas lands in Crane County, Texas, was a seismograph discovery as a result of both refraction and reflection surveys over a period from 1937 to 1944. These surveys are discussed and maps are presented.

The discovery well, The Atlantic Refining Co. 1-A University, Section 33, Block 31 UTL, Crane County, Texas, was completed November 19, 1945. The field produces from beds of Devonian and Ordovician (Ellenburger) ages.

S.E.P.M. DIGESTS

A Brief Review of Stratigraphy And Micropaleontology of The Los Angeles Basin

STANLEY G. WISSLER and F. D. CRAWFORD, Union Oil Co. of California, Los Angeles.

ROCKS penetrated by wells of the Los Angeles basin range in age from recent alluvium to the Jurassic schist of the Franciscan formation which forms the basement rock west of the Inglewood-Newport fault zone. Strata of middle Miocene age have been cored in several fields of the Inglewood-Newport line. Many wells west of the fault zone have reached the schist basement after penetrating varying thicknesses of sandstone and shale of Pleistocene, Pliocene, and upper Miocene age. A few wells near the southeastern margin of the basin have encountered sediments of lower Tertiary and Cretaceous age, but the majority have bottomed in the upper Miocene.

From a study of core samples the foraminiferal sequence has been determined in detail from the middle Miocene well up into the Pleistocene. By means of index Foraminifera the subsurface section is divided into a number of major divisions. From the surface downward these are: the Palos Verdes formation (upper Pleistocene); the San Pedro formation (lower Pleistocene); the upper, middle, and lower Pico (upper Pliocene); the upper, middle, and lower Repetto (lower Pliocene); and Divisions A, B, C, D, and E of the Delmontian and Mohnian stages of the upper Miocene. Each of these major units is further sub-

divided into zones, subzones, and horizons, based upon intermittent occurrences or marked changes in the abundance of long-ranging species together with variations in the general faunal assemblage. Many of the minor faunal horizons, as well as the major faunal units, can be traced over the greater part of the basin irrespective of the frequent lithologic variations which often make long-range correlation by electric logs extremely difficult.

The Ventura Basin

GEORGE C. KUFFEL, Shell Oil Co., Inc., Long Beach, Calif.

THE area included in this discussion is made up of the San Fernando Valley, the Santa Clara River Valley, and the coastal belt from Point Mugu on the south to Point Conception on the north.

Stratigraphically, the section penetrated by wells in the area is unusual in that the thickness of post-Miocene sediments is about 20,000 ft. General uniformity of the lithology and the complicated structures in the Pliocene rocks have stimulated the use of micropaleontology as the most practical means of correlation.

A composite geologic column will be shown to illustrate the formational divisions and the microfaunal distribution by which the various units are recognized will be discussed.

Stratigraphy of Sacramento Valley

PAUL P. GOUDKOFF, consultant, Los Angeles.

THE paper deals with the part of the Great Valley north of the Mt. Diablo Meridian Base. Features to be discussed are: formational divisions of sediments developed in the area; location of typical exposures of various formations; general pattern of the distribution of marine sediments (appearance of progressively younger and younger strata in the direction from northwest to southeast, disappearance of several older formations towards the east side of the valley, and peculiar stratigraphic relations near the southern boundary of the valley); variation in lithological composition and in thickness of various members of the geologic column.

Stratigraphy of the Central Part of the Great Valley

BORIS LAIMING, The Texas Co., Los Angeles.

THIS paper reviews the principal features of the stratigraphy of the Great Valley within an area about 200 miles long and 60 miles wide, which extends from the latitude of Mt. Diablo on the north to the Lost Hills oil field on the south. The paper

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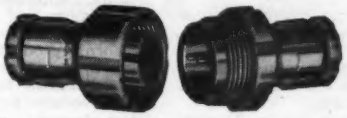

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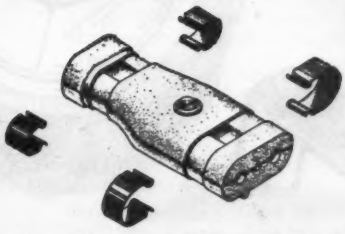

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is illustrated with slides showing: the areal distribution of the principal stratigraphic units, generalized columnar sections in typical areas, correlations of formations and time units, principal fossils used in correlating, the occurrence of oil and gas in the stratigraphic column, and some typical examples of that occurrence in the principal producing fields.

Minute Spore-Like Fossils From Upper Cretaceous Shales

DANIEL J. JONES and H. M. BARTON, Phillips Petroleum Co., Bartlesville, Okla.

THE use of the electron microscope has revealed the occurrence of extremely small spore-like fossils in the Eagle Ford shales of East Texas. These minute microfossils range in size from less than 1 micron up to 5 microns in diameter.

Techniques of examining the fossils with the electron microscope are discussed, and electron micrographs of many types of the microfossils are shown. Certain new problems in paleontological procedure have arisen in connection with electron microscopy, and these are discussed.

Stratigraphy of the Santa Maria District

ADEN W. HUGHES, Union Oil Co. of California, Orcutt, Calif.

THE Santa Maria district is located near the coast in northern Santa Barbara County, approximately midway between Los Angeles and San Francisco. The area is somewhat isolated with respect to other California production, both as to structural features and type of oil. Basement rock is the Franciscan formation of Jurassic age. It is overlain by the Knoxville series of latest Jurassic, which is the oldest producing horizon. The Lospe, land-laid sediments, bridges the gap between Knoxville and middle Miocene, having a possible age range of Eocene to lower Miocene. The Monterey shale, middle and upper Miocene, is an argillaceous to siliceous and cherty shale which is both source and reservoir rock for most fields in the district. Pliocene beds are represented by the Sisquoc, Foxen, and Careaga formations. The Pleistocene strata of Paso Robles age are overlain locally by ancient and active dune sand.

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Shales and Their Environmental Significance

W. C. KRUMBEIN, Northwestern University, Evanston, Ill.

THIS paper discusses properties of shales which may be significant in reconstructing environments of deposition. The properties include variations in composition, textures, sedimentary structures, and contained organisms. Some of these attributes are nondiagnostic in single samples, but combinations of the properties in sets of related samples do furnish clues to the environment. Consideration is also given to the relations between tectonic deformation of the source area and attributes of the derived shales.

Properties of Sandstones Resulting From Environmental Conditions

E. C. DAPPLES, Northwestern University, Evanston, Ill.

CERTAIN physical parameters such as size distribution, grain shape, mineralogy, bedding, grain arrangement, and surface texture are shown to be affected by environmental conditions in source areas and in the zones of deposition. This permits the establishment of classes based upon the dominant properties impressed upon the sands prior to cementation. Conversely the sandstone classes can be used to indicate paleogeologic conditions of source and depositional areas.

Environmental Significance Of Conglomerates

W. H. TWENHOFEL, University of Wisconsin, Madison.

ALL sediments are consequences of inheritance and environment. This is true of conglomerates as well as other sediments. However, particles in the range from granules to boulders may be deposited under many environmental conditions of which each will impress upon the aggregate some characters peculiar to the conditions under which deposition took place. The various environmental conditions under which particles which make conglomerates are deposited are examined and an attempt is made to point out the particular characters which result from deposition in the several environments.

Stratigraphy of San Joaquin Valley

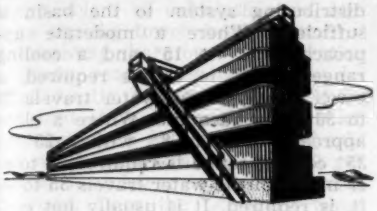
WILLIAM F. BARBAT, Standard Oil Co. of California, San Francisco.

THE Tertiary section exposed on the northeast side of the Temblor range is considered most typical of the southern San Joaquin Valley. This section is reviewed. It consists of 200 ft. of Paleocene sediments resting on an unknown thickness of upper Cretaceous beds, 6,000 ft. of Eocene sediments, and 8,500 ft. of Miocene sediments. The Pliocene sediments are very incompletely exposed. The major faunal zones are described, and gaps in the exposed section are filled in by paleontologic correlations with nearby well sections.

COOLING-TOWER Performance

Evaluated for the Operator

by James G. De Flor*



THE heat-transfer process involves a latent heat transfer due to change of state of a small portion of the water from liquid to vapor and a sensible heat transfer due to the difference in temperature of water and air. Approximately 1,000 B.t.u. are required to evaporate 1 lb. of water, which is the amount of heat lost in cooling 100 lb. of water 10°. Therefore, for each 10° of cooling effected, roughly 1 per cent of water is lost by evaporation. In addition, there will be a spray loss of not more than 0.2 per cent in a well-designed atmospheric or mechanical draft tower. Water cooling from 120° to 90°, for example, will therefore lose 3.2 per cent of its weight (3 plus 0.2 per cent) with each passage through the tower.

*Chief cooling tower development engineer, The Fluor Corp., Ltd.

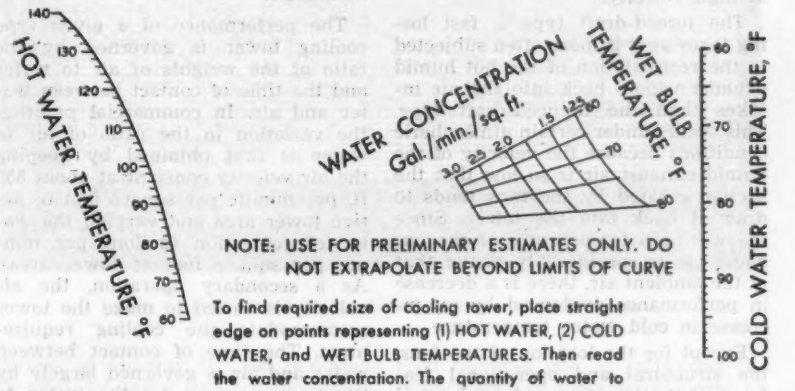


Fig. 2—Performance curve of a counter-flow, induced-draft cooling tower with upspray distributing system containing 24 ft. of filling

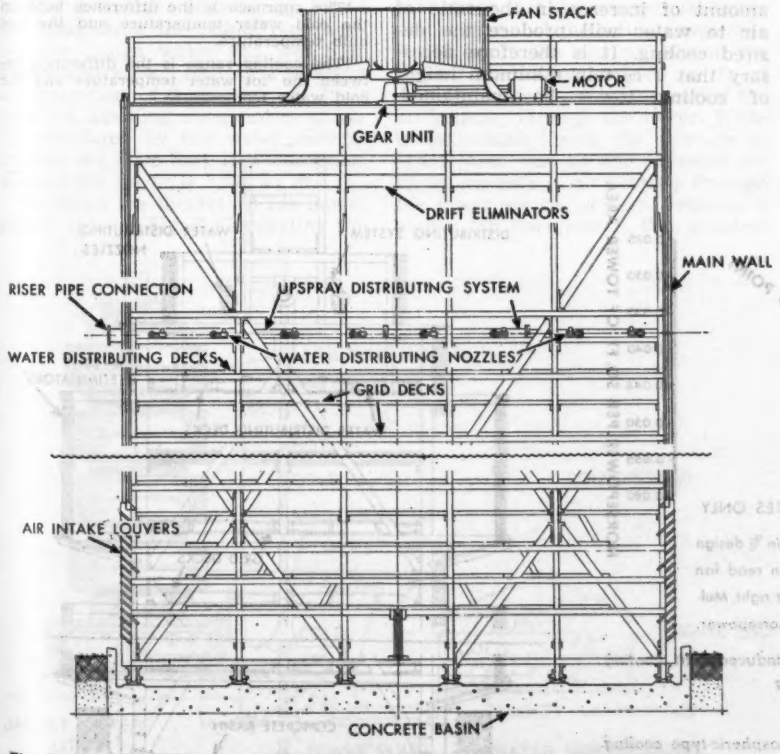


Fig. 1—Cross-sectional view of a mechanical-draft cooling tower. With the upspray distribution system, it is necessary to allow sufficient space between the drift eliminators and the nozzles for a spray chamber

In cooling towers in which the water is warmer than the air, the heat removed from the water and transferred to the air is the sum of the sensible heat and the latent heat of evaporation. The sensible heat q_s is small compared to the transferred latent heat, wr.

$$q_t = q_s + wr$$

$$w = kA_d p_m$$

The factors which influence the performance of a cooling tower are therefore those which affect the expression $kA_d p_m$. The value kA depends on the construction of the equipment, the extent of water surface exposed through drop surface and filming surface, and the velocity of the air. $_d p_m$ depends on the temperature of the water and the temperature and humidity of the air. Actually, $_d p_m$ represents the difference in vapor pressure between the water at its temperature and the water if it were at the wet-bulb temperature of the air.

General Considerations

There are two types of cooling towers in general use today—the atmospheric and the mechanical draft. The older apparatuses for cooling water, i.e., the spray pond and natural-draft

chimney towers, have been replaced almost exclusively by these two types of cooling towers.

Mechanical Draft Towers

There are two types of mechanical draft towers in use today—the forced draft and the induced draft. In the forced-draft tower, the fan is mounted at its base and the air is forced in the bottom and discharged through the top at low velocity. In the induced-draft tower, the fan is mounted on the roof of the structure and air is pulled upward and discharged at high velocity.

The forced-draft type is fast losing favor as it is more often subjected to the recirculation of the hot humid exhaust vapors back into the air intakes than the induced-draft type. This occurs under certain atmospheric conditions because the velocity of the humid exhaust air is so low that the suction created by the fans tends to draw it back into the tower. Since the wet-bulb temperature of the exhaust air is considerably above that of the ambient air, there is a decrease in performance evidenced by an increase in cold water temperature.

Except for the location of the fans, the structural and operational features of the two types of mechanical draft towers are essentially the same. A cross-sectional view of the induced-draft tower with the various parts labeled is shown in Fig. 1. The entrained moisture is removed from the exhaust air by the drift eliminator, which is placed just above the spray chamber and below the fan. The water is pumped to the main header located in the top of the tower where it is distributed to the various nozzles. This water is sprayed up in a manner similar to that used in a spray pond and is mixed ultimately with the exhaust air before dropping to the decks below. In performance, the upspray distributing system represents the equivalent of adding 8 or 9 ft. to the height of the cooling tower over that of the gravity-type system. The fall of the water is interrupted by the slat-type grids as it flows countercurrently to the air. In flowing countercurrently, the coldest water contacts the driest air and the warmest water contacts the most humid air.

The performance of a given type cooling tower is governed by the ratio of the weights of air to water and the time of contact between water and air. In commercial practice, the variation in the ratio of air to water is first obtained by keeping the air velocity constant at about 350 ft. per minute per square foot of active tower area and varying the water concentration (gallons per minute per square foot of tower area). As a secondary operation, the air velocity is varied to make the tower accommodate the cooling requirement. The time of contact between water and air is governed largely by the time required for the water to discharge from the nozzles and fall through the tower to the basin. The time of contact is, therefore, obtained in a given type of unit by varying the height of the tower. Should the time of contact be insufficient, no amount of increase in the ratio of air to water will produce the desired cooling. It is therefore necessary that a certain minimum height of cooling tower be maintained. Where a wide approach* of 15° to 20° to the wet bulb temperature and a 25° to 35° cooling range† is required, a relatively low cooling tower will suffice. A tower in which the water travels 15 to 20 ft. from the distributing system to the basin is sufficient. Where a moderate approach of 8° to 15° and a cooling range of 25° to 35° is required, a tower in which the water travels 25 to 30 ft. is adequate. Where a close approach of 4° to 8°, with a 25° to 35° cooling range is required, a tower in which the water travels 35 to 40 ft. is required. It is usually not economical to design a cooling tower with an approach of less than 4°, but it can be satisfactorily accomplished with a tower in which the water travels 35 to 40 ft.

Fig. 2 shows the relationship of the hot water, cold water and wet bulb temperatures to the water concentration. From this, the minimum area required for a given performance of a well-designed counterflow induced draft cooling tower can be obtained. Fig. 3 gives the horsepower per square feet of tower area required for a given performance. Those curves do not apply to parallel or crossflow cooling since these processes are not as efficient as the counterflow process. Also they do not apply where the approach to the cold water temperature is less than 5°.

The cooling performance of any tower containing a given depth of

*The approach is the difference between the cold water temperature and the wet bulb temperature.

†The cooling range is the difference between the hot water temperature and the cold water temperature.

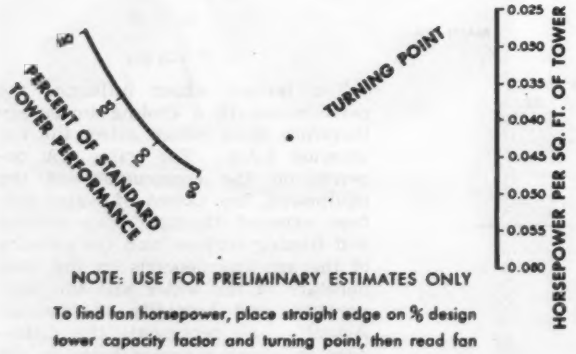

PERCENT OF STANDARD TOWER PERFORMANCE
TURNING POINT
HORSEPOWER PER SQ. FT. OF TOWER AREA
0.025
0.030
0.035
0.040
0.045
0.050
0.055
0.060
NOTE: USE FOR PRELIMINARY ESTIMATES ONLY
To find fan horsepower, place straight edge on % design tower capacity factor and turning point, then read fan horsepower per square foot of tower area at right. Multiply tower area by this factor to obtain fan horsepower.

Fig. 3—(Above) Fan horsepower curve for induced-draft cooling towers with 24 ft. of filling

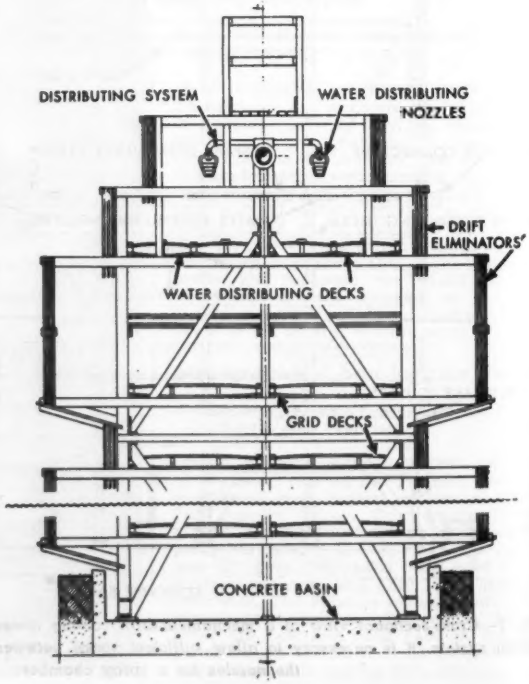


Fig. 4—(Right) Cross-sectional view of an atmospheric-type cooling tower. The function of the drift eliminators on the sides is to separate entrained water from the discharging air stream, reducing airborne drift loss to a minimum

filling varies with the water concentration. It has been found that the maximum contact and performance is obtained with a tower having a water concentration of 2 to 3 g.p.m. per square foot of ground area. Thus, the problem of calculating the size of a cooling tower becomes one of determining the proper concentration of water required to obtain the desired results. A higher tower will be required if the water concentration falls below 1.6 gal. per sq. ft. Should the water concentration exceed 3 gal. per sq. ft., a lower cooling tower may be used. Once the necessary water concentration is obtained, the tower area can be calculated by dividing the gallons per minute circulated, by the water concentration gallons per square foot. The required tower size then is a function of the following:

1. Cooling range (hot-water temperature minus cold water temperature).
2. Approach to wet bulb temperature (cold-water temperature minus wet bulb temperature).
3. Quantity of water to be cooled.
4. Wet bulb temperature.
5. Air velocity through the cell.
6. Tower height.

To illustrate the use of the charts let us assume that we have the following cooling conditions:

Hot-water temperature = 102°.
Cold-water temperature = 78°.
Wet bulb temperature (Twb.) = 70°.
G.p.m. = 2,000.

Laying a straight edge across Fig. 2 and connecting the points representing the design water and wet bulb temperatures, we find that a water concentration of 2 gal. per sq. ft. is required. Dividing the quantity of water circulated by the water concentration, we find that the theoretical area of the tower is 1,000 sq. ft.

To obtain the theoretical fan horsepower, we use Fig. 3. Connecting the points representing the 100 per cent of standard tower performance with the turning point, we find that it will require 0.041 hp. per sq. ft. of actual effective tower area. Multiplying by the tower area of 1,000 sq. ft., we find that it requires 41.0 fan horsepower to perform the necessary cooling.

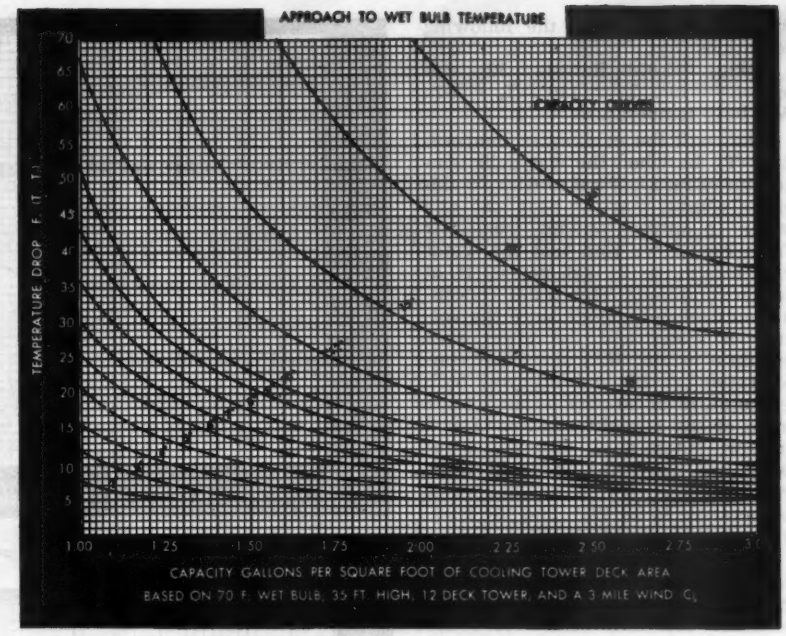

APPROACH TO WET BULB TEMPERATURE
TEMPERATURE DROP F. (T - T1)
CAPACITY GALLONS PER SQUARE FOOT OF COOLING TOWER DECK AREA
BASED ON 70 F. WET BULB, 35 FT. HIGH, 12 DECK TOWER, AND A 3 MILE WIND

Fig. 6—Capacity curves for atmospheric-type cooling towers

Suppose that the commercial tower size is such that the actual tower area is 910 sq. ft. We can still obtain the cooling equivalent to 1,000 sq. ft. of standard tower area by increasing the air velocity through the tower. Within reasonable limits, the shortage of actual area can be compensated for by an increase in air velocity through the tower which, in turn, requires a higher fan horsepower. Our problem then becomes one of increasing the performance of the smaller tower by 10 per cent. From Fig. 3, by connecting the points representing 110 per cent of standard tower performance and the turning point, the fan horsepower is found to be 0.057 hp. per sq. ft. of actual tower area, or 0.057 × 910 = 51.9 hp.

On the other hand, suppose the commercial tower size is such that the actual tower is 1,110 sq. ft., the cooling equivalent to 1,000 sq. ft. of standard tower area can be accomplished with less air and less fan horsepower. By the use of Fig. 3, the theoretical fan horsepower for a tower doing only 90 per cent of standard performance is found to be 0.031 per sq. ft. of actual tower area or 34.5 hp.

Let's assume that we have the same cooling range and approach as used in the first example, except that the wet bulb temperature is lower. The design conditions would then be:

G.p.m. = 2,000. Range = 24°. Approach = 8°. T_1 = 92°. T_2 = 68°. Wet bulb temperature (Twb.)= 60°.

From Fig. 2, we find the water concentration required to perform the cooling is 1.75, giving a theoretical tower area of 1,145 sq. ft. as compared with 1,000 sq. ft. for a 70° wet bulb temperature. This shows that the lower the wet bulb temperature for the same cooling range and approach, the larger the area of the tower required and therefore the more difficult the cooling job.

The problem of estimating the performance of an existing tower at other than design conditions is often encountered by the plant operator. For example, suppose we have a tower

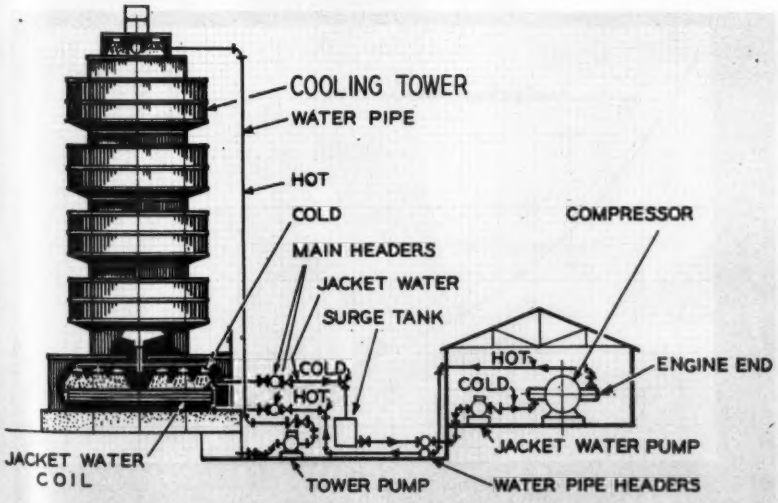


Fig. 5—Typical flow diagram for a closed cooling system utilizing the coil-type atmospheric cooling tower

that was designed for the following conditions:

G.p.m. = 1,000. Range = 30°. Approach = 10°. T_1 = 110°. T_2 = 80°. Wet bulb temperature = 70°.

What will the cold-water temperature (T_2) be when the wet bulb temperature (Twb.) drops to 60°, providing of course, that the heat load and water quantity remain constant? From Fig. 2, we find that the water concentration is 2.0 gal. per sq. ft. at design conditions. This water concentration does not change since the volume of water and the tower area remain constant. With the water concentration at 2.0 and the wet bulb temperature at 60°, by adjusting the angle of the straight edge on Fig. 2 until we obtain a 30° differential between the hot-water and cold-water temperatures, we find the hot-water temperature to be 103°, and the cold-water temperature to be 73°.

Suppose now, that the above designed tower had 1,500 g.p.m. flowing through it, and the total heat load remained constant, what would the cold-water temperature be when the wet bulb temperature is 65°? The design load was:

$$1{,}000 \times 8.33 \times 30 = 250{,}000 \text{ B.t.u. per minute}$$

The new cooling range (heat load remaining constant) when circulating 1,500 g.p.m. over the tower would be:

$$\frac{250{,}000}{1{,}500 \times 8.33} = 20.0°$$

Theoretically, the design area of the tower from Fig. 2 was 500 sq. ft. (1,000 g.p.m. ÷ 2.0 gal. per sq. ft. = 500 sq. ft.). The water concentration when circulating 1,500 g.p.m. is:

$$\frac{1{,}500}{500} = 3.0 \text{ gal. per sq. ft.}$$

Now, referring to Fig. 2, with a water concentration of 3.0 gal. per sq. ft. and 65° wet bulb temperature, adjust the straight edge until a difference of 20° exists between the hot-water and cold-water temperatures. This shows the hot-water temperature to be 100° and the cold-water temperature to be 80°.

This indicates that the possibility of a lower cold-water temperature obtained by the lower existing wet-bulb temperature was lost due to the adverse effect of the increased water quantity.

Cooling-Tower Spray Nozzles

Referring to the types of nozzles used in upspray cooling tower distributing systems, the accompanying Table 1 gives the performance of a particular family of nozzles. In upspray distributing systems, a pressure of 7 psi. is common practice; however, 5 lb. is adequate.

This nozzle is of the nonclogging

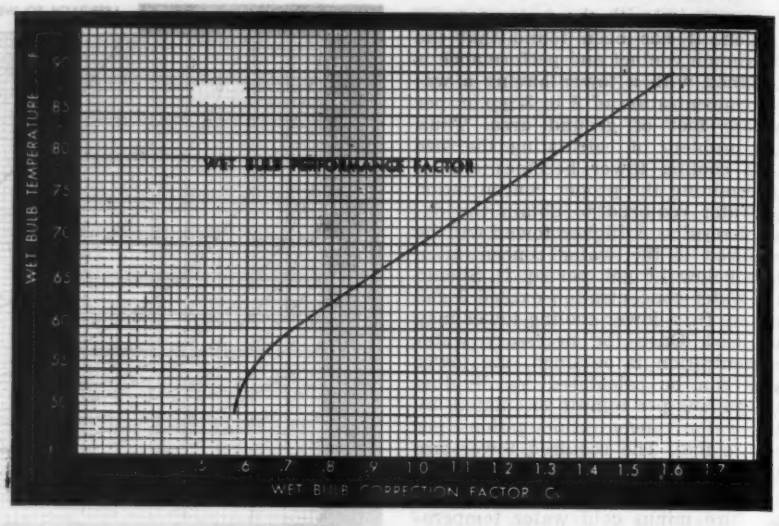


Fig. 7—Wet-bulb performance factor

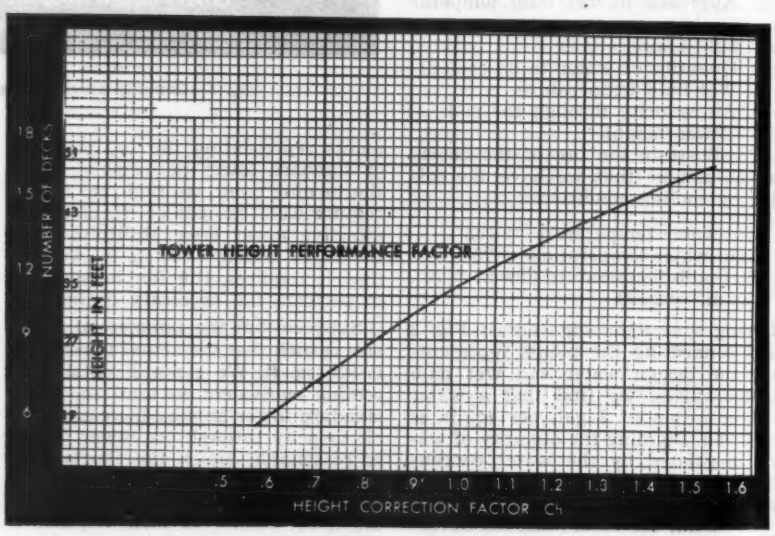


Fig. 8—Tower height performance factor

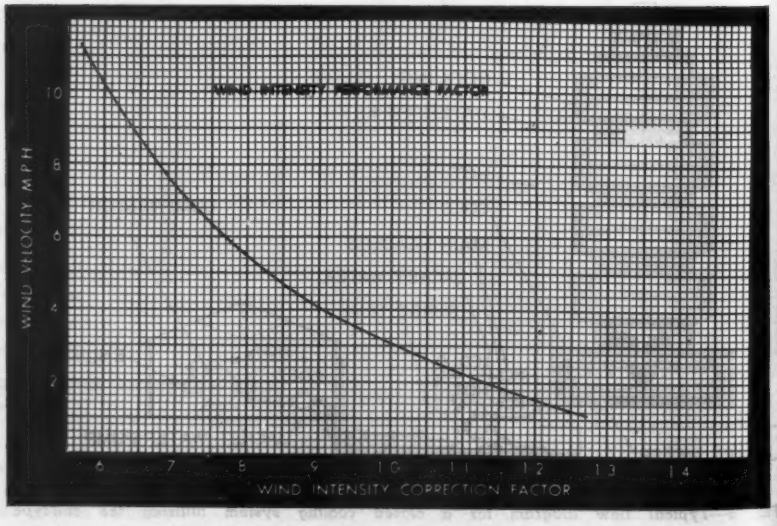


Fig. 9—Wind-intensity performance factor

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type. It does not depend on small orifices to obtain minimum drop size but, rather, upon centrifugal force. The water is given a spiral action by its tangential entrance into the spiral chamber. The dome-shaped approach to the discharge orifice increases this spiral action as it approaches the discharge orifice. This whirling action, which generates the necessary velocity for fine breakup, assures uniform drop size and efficient water distribution over a maximum area. This formation of uniformly small drops assures maximum contact with air, resulting in high cooling efficiency.

Atmospheric Cooling Towers

In atmospheric towers (Fig. 4) the water is pumped to the top of the tower, where it is discharged through a distributing system. As the water begins its downward flow, it is broken up and redistributed by the decks that comprise the filling of the tower. This continually creates newly exposed cooling surface for the air (passing horizontally through the tower) to encounter. The redistribution insures even concentration of water throughout the tower during its entire fall.

Although initial cost for an atmospheric cooling tower (designed for a 3-m.p.h.) is about the same as that for a mechanical-draft tower, there are certain important limitations governing its performance. It must be located broadside to the prevailing wind in an exposed area. Any surrounding structures, hills, or other barriers would tend to block off the wind.

Originally, the main objection to atmospheric towers was the excessive spray loss occurring during periods of high winds. This high loss was caused by the lack of a method of separating the entrained water from the air in the conventional louver-type tower. As a result, most manufacturers now have solved this problem by means of incorporating drift eliminators into the louvers.

The method of determining the size and performance of an atmospheric-type tower is shown on the accompanying charts. The purpose of these charts is to show the method of estimating the approximate size of an atmospheric type cooling tower to meet a given demand. The cooling capacity of any tower, with a given wet bulb temperature and wind velocity, varies with the water concentration.

The concentration required to produce desired cooling depends primarily on the following conditions:

1. Temperature range (T_1—T_2).
2. Approach to wet bulb temperature (T_2—Twb.).
3. Tower height.
4. Wind velocity.
5. Wet bulb temperature (Twb).

Because of the infinite number of possible combinations of these values, it is impracticable if not impossible to have one curve from which to obtain the correct concentration factor. Fig. 6 gives the required concentration for cooling water through a certain range and with a certain approach to the wet bulb temperature, but this curve assumes a wet bulb temperature of 70° F., tower height of 35 ft., and a wind velocity of 3 m.p.h. Let us assume that the conditions given are unity. Then should any of these three values change, the concentration would have to be corrected for the new conditions by using one or more of the correction factors shown on Figs. 7, 8, and 9.

Let us see how a variance of any of the three aforementioned conditions would affect the concentration of water.

1. Wind velocity.—The higher the wind velocity the greater the amount of air that goes through the tower. This results in greater cooling. Therefore, when the wind velocity is higher, the concentration can be greater and still obtain equal cooling.

2. Tower height.—In general, it is found in atmospheric as well as mechanical-draft towers that the greater the cooling range and the closer the approach to the wet bulb temperature, the higher will be the tower required to give sufficient time of contact between water and air to accomplish the desired cooling. In atmospheric towers, the performance is limited by both maximum and minimum water concentrations. Should the water concentration fall below 1 g.p.m. per sq. ft. of tower area, it will be necessary to employ the next size higher tower. This is because in extremely light water concentrations the water will not be uniformly distributed and the performance as predicted by the accompanying curves will not be achieved. Should the water concentration exceed 3 g.p.m. per sq. ft. of tower area, it will then be necessary to choose the next size lower tower.

3. Wet bulb temperature.—Theoretically, a cooling tower cannot cool water to a temperature lower than the prevailing wet bulb temperature. Being limited by this fact, one is more interested in the economic approach of the cold-water temperature to said temperature. Air has a greater capacity for absorbing heat at the higher wet bulb temperatures. At the lower wet bulb, air, in passing through the tower, must have a greater temperature rise to accomplish the same cooling. Therefore, to obtain the same approach at the lower wet bulb temperatures it is necessary to reduce the concentration.

TABLE 1—CAPACITY TABLE FOR COOLING TOWER UPSPRAY NOZZLES

Nozzle No.	Pipe size	Orifice size	Pressure in pounds per square inch: 5	6	7	8	9	10	12	15	20	25	30
			Capacity in U. S. gallons per minute										
2.4	⅜″	7/64″	...	...	1.0	1.1	1.2	1.3	1.4	1.6	1.8	2.0	2.2
2.4	⅜″	7/64″	1.8	1.9	2.1	2.2	2.3	2.3	2.7	3.0	3.4	3.8	4.2
7	1″	7/32″	6.5	7.1	7.7	8.2	8.7	9.2	10.1	11.3	13.1	14.6	16.0
14	1″	5/16″	11.5	12.6	13.6	14.5	15.4	16.2	17.7	19.8	22.7	25.3	27.8
19	1½″	7/16″	16.8	18.3	19.8	21.1	22.4	23.5	25.8	28.7	32.9	36.5	40.0
24	1½″	1″	20.0	22.0	23.8	25.3	26.9	28.3	31.0	34.7	40.0	44.8	49.0
39	2″	1¼″	33.0	36.2	39.0	41.8	44.3	46.7	51.0	57.0	65.8	73.3	80.0
49	2½″	1 25/32″	39.5	43.0	46.5	49.5	52.5	55.0	60.5	67.0	78.0	86.0	94.0

To calculate the size of an atmospheric type cooling tower with effective width of 12 ft. the following general formula may be used:

$$L = \frac{GPM \times W}{C \times 12 \times Cw \times Ch}$$

when:

L = length of tower, (ft.)
GPM = quantity of water (g.p.m.)
W = wind correction factor
C = concentration of water per square foot of cooling-tower area
Cw = wet bulb correction factor
Ch = tower-height correction factor
T_1 = inlet temperature
T_2 = outlet temperature
($T_1 - T_2$) = temperature range
Twb. = wet bulb temperature
(T_2 — Twb.) = approach to wet bulb temperature

Problem 1.—Determine the length of a 35-ft. high tower required to cool 1,500 g.p.m. from 90° to 75° F. with a 70° F. wet bulb temperature and a 3-m.p.h. wind. From these conditions we know that the approach (T_2 — Tw) = 5° F. and the range ($T_1 - T_2$) = 15° F. From Fig. 6, it is found that these two values require a concentration of C = 1.17. The correction factors, Ch, Cw, and W will be equal to one, as shown on their respective correction factor curves, because Fig. 6 was based upon values equal to those given in the problem. Substituting the corresponding values on the above formula we find that a tower 107 ft. long is required.

Problem 2.—Let us take the same conditions that exist in Problem 1 and see what the effect would be when the wind velocity is increased to 5 m.p.h. From Fig. 9, when the wind velocity is 5 m.p.h., W = 0.80. Substituting this value for W in the formula, we find that an 85.3-ft.-long tower is required.

Problem 3.—Again assume the same conditions as Problem 1, except that due to space considerations it is necessary to have a 51-ft.-high tower. From Fig. 8, when tower height is

(Continued on page 169)

Carthage Approaching Full Gas Production

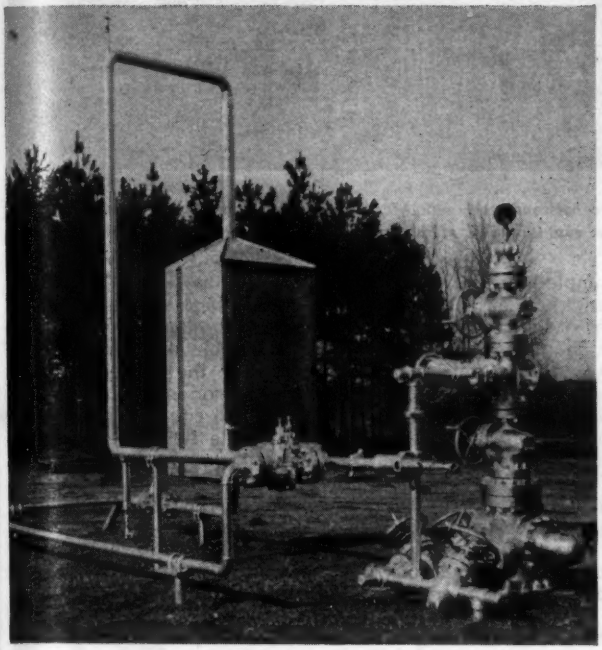
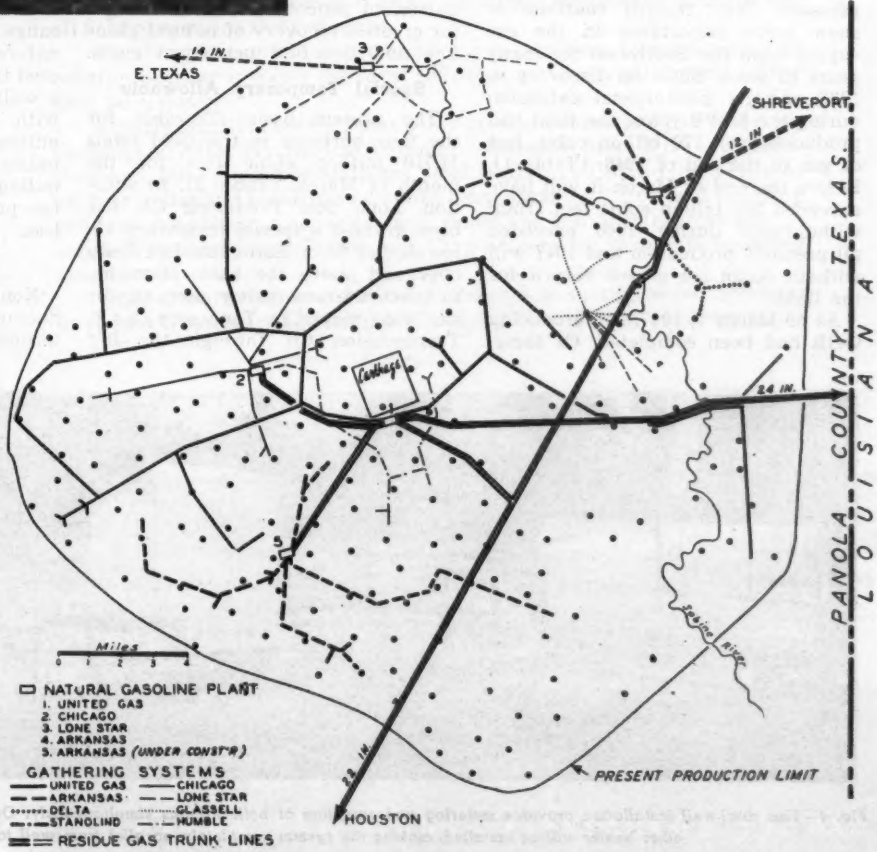


Fig. 1—(Right) Principal gathering systems and pipe-line outlets of the Carthage field

Fig. 2—(Above) As in most Carthage wells, both gas and condensate are charged directly from this dual well to the gathering system. The streams are combined ahead of the vertical sampling loop and meter run, requiring the shutting in of one horizon if a separate g.p.m. test is to be made of the other

by George Weber

Since its discovery in 1936, Carthage has produced more than 170 billion cubic feet of gas to the end of 1946. By the end of March it will have exceeded 200 billion cubic feet.



CARTHAGE, the greatest single reserve of available high-pressure gas to be discovered in this country, has not yet reached the stage of settled fieldwide production. Rapid drilling during the past 2 years outstripped the installation of sufficient gathering and processing facilities for handling allowable gas and condensate and about 16 per cent of all wells now completed still remain unconnected to pipe-line outlets.

With the decline in field drilling since the first of this year, construction of gathering systems and extraction plants is expected

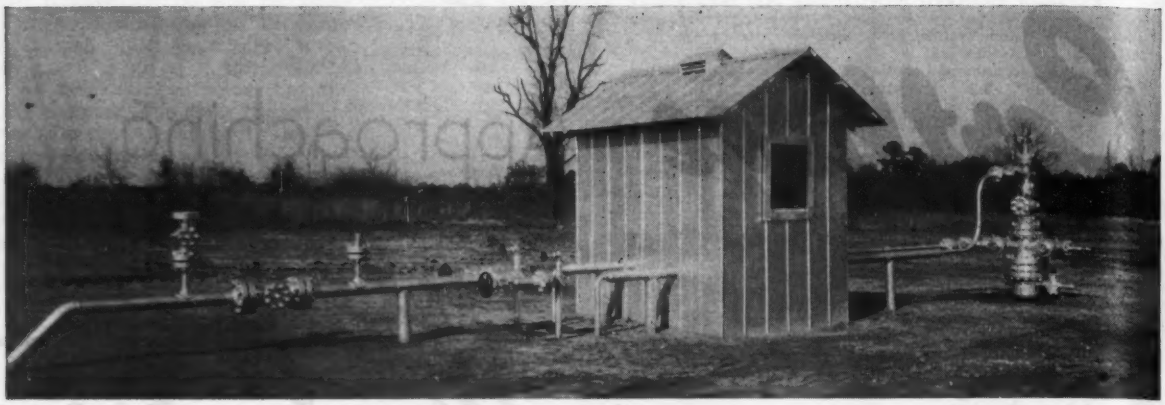


Fig. 3—In this simple dual-well installation, the streams from the two horizons are handled for metering and sampling in parallel lines. The vertical sampling loop, placed downstream from the horizontal meter run, is buried, giving easy access to connections for the sampling tips

by midyear to provide all wells with adequate connections. Further drilling in proven and outpost locations is anticipated. The field, now covering a proven area of approximately 280,000 acres, may yet exceed 300,000 acres provided possible eastward extensions are realized.

Carthage is considered the second greatest reserve of high-pressure gas and condensate in this country, although some estimate it to outrank the Katy field of Gulf Coast Texas. In the absence of cycling, however, Carthage provides the greatest present productive potential of any high-pressure field. It will continue to show great importance in the gas supply from the Southwest for many years to come. Since its discovery in 1936 and its phenomenal extension during the past 3 years, the field had produced over 170 billion cubic feet of gas to the end of 1946. (Table 1). Before the end of March it will have exceeded 200 billion cubic feet. Total withdrawals during 1946 exceeded all previous production and 1947 will without doubt set a new record for the field.

As of March 1, 1947, 247 producing wells had been completed. Of these, 157 were dual completions in two of the four producing horizons and 90 were single wells, giving a producing total of 404 wells. In allowable schedules, each dual well is assigned two separate allocations and is considered as two wells. In early March about 84 per cent of all wells were connected to established gathering systems and about 72 per cent were flowing to extraction plants. (Table 2). Four natural-gasoline-extraction plants are now in operation and a fifth is nearing completion. Expansion of overloaded plants and the possible addition of new plants will be required to process all allowable gas for greatest recovery of natural gasoline and liquefied petroleum gases.

Special Temporary Allowable

The present basic allowable for the four horizons in the field totals 11,710 million cubic feet for the month of March. (Table 3). In addition, Lone Star Producing Co. has been granted a special temporary allowable of 60 million cubic feet daily over and above the basic allowable to meet the emergency demand for gas being moved by Tennessee Gas & Transmission Co. through the Big Inch line to the East. This added allowable has been extended through March and is charged against the regular allowable of the connections now meeting the added demand, whose production must be cut back after April 1 to equalize withdrawals on an equitable fieldwide basis during the following months.

Of the four producing horizons, the Upper and Lower Pettit comprise the greatest reserve, and are allotted over 90 per cent of allowable production. Porosity, permeability, formation pressures, and pay thicknesses vary over the anticlinal structure and wells show potentials of a wide range. Weak edge wells of marginal nature contrast with what is considered the largest gas well in the world, a well in the south part of the field with an open-flow potential of 700 million cubic feet per day. Many wells indicate open-flow potentials of 100 million cubic feet daily, but the average producer will show 50 million or less.

Reserve Estimates Vary

Nonuniformity of the porous producing sections renders accurate determination of gas reserves virtually

Fig. 4—This dual-well installation provides metering and sampling of both streams simultaneously. One of the streams is heated and another heater will be installed, making the system completely parallel from well to gathering line

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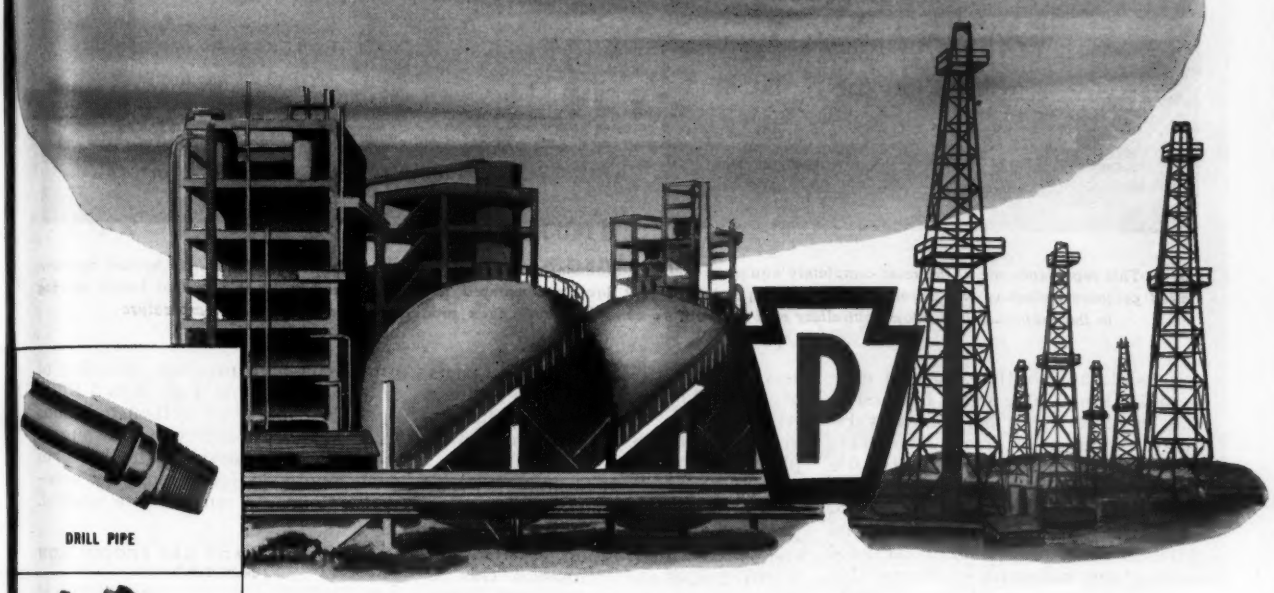
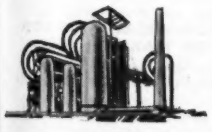


DRILL PIPE

OIL WELL CASING AND TUBING



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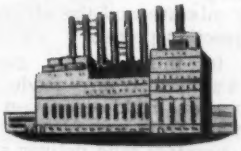

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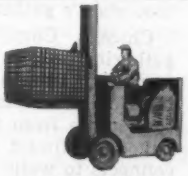

8-WAY PALLETS AND CARGOTAINERS

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Fig. 5—This represents one of the most completely equipped well installations in the field. Production from each horizon is heated between staged pressure reduction and separated, after which both gas and liquid are metered, then recombined and again heated before moving to the gathering line. Flow controllers and temperature controls assure even production at a prescribed temperature

impossible at this time, current estimates falling in a wide dispersion. Gas in place in all horizons is variously estimated at from 4 to 11½ trillion cubic feet, the figure 6½ trillion representing a conservative total accepted by many geologists and engineers. The field will be produced with only a minor amount of local cycling, and estimates of recoverable condensate are beyond any accurate means of computing at present.

The field is served by five major gathering systems and a number of smaller ones which connect to plants or pipe lines. (Fig. 1). The most extensive, a loop system operated by United Gas Pipe Line Co., includes about 80 miles of main line and 40 miles of smaller feeder lines serving 115 wells. In addition to the combined production from wells connected to this system, the company takes separator gas directly into its trunk pipe lines from wells and central separator batteries in the northeast sector of the field. Until completion of the new Arkansas-Louisiana Gas Co. plant in the southwest part of the field, United is also taking the production from that plant's gathering system.

Chicago Corp. operates its own gathering system extending radially from its plant in the west sector of the field. This plant receives gas and condensate from the 18-mile Humble Oil & Refining Co. system which connects to wells in the center of the field. The southeastern portion of Carthage, in which are located most of the currently unconnected wells, will be served by a cooperative gathering system to be constructed and operated by Sun Oil Co. This system is expected to include about 75 miles of main and feeder lines moving gas and condensate to the Chicago plant. It is scheduled for initial operation by July. Lone Star Producing Co. and Arkansas-Louisiana Gas Co. serve the north and northeast parts of the field with gathering systems which move combined production and separator gas to their respective plants.

Separator gas and residue gas from plants find four outlets from the field. The Lone Star line serves that company's distribution system in North Texas and Tennessee Gas & Transmission Co., temporarily operating the Big Inch line. The trunk line from the northeast sector feeds Arkansas-Louisiana Gas Co.'s distribution system to the north. Gas from the remaining plants is divided between two United Gas pipe lines, one traversing the field between the Texas Gulf Coast and north Louisiana, and the other leading to the Monroe area of northeast Louisiana.

G.P.M. Tests on Wells

The condensate recovery varies considerably in the field. Full-scale separators will recover from 9 to 30 bbl. per million cubic feet, the average being about 15 to 16 bbl. Plant recoveries from total production range from 20 to 32 bbl. per million, depending on the richness of the incoming mixture and the efficiency of the extraction process.

Due to this variable gas-liquid ratio, g.p.m. tests are made at the well location. Field separation of raw condensate from gas is practiced by a few operators who deliver stripped gas to plants or pipe lines and market condensate separately. The remainder either separate gas and liquid at the well for measurement and recombine, or charge total production directly to gathering lines without separation. Most operators determine g.p.m. by testing the mixed stream regularly, sampling with tips set at the top of vertical loops. Sampling procedure follows the conditions specified by the N.G.A.A. research project on high-pressure sampling of two-phase streams. Figs. 2 to 5 illustrate the variety of well installations in the field, ranging from simple metering and sampling hookups to wells equipped for completely automatic flow and temperature control.

TABLE 1—CARTHAGE GAS PRODUCTION M.M.C.F.*

Year	Yearly total	Cumulative to end of year
1936	75	75
1937	1,120	1,195
1938	745	1,940
1939	763	2,703
1940	2,212	4,915
1941	4,202	9,117
1942	6,198	15,315
1943	11,270	26,585
1944	21,727	48,312
1945	32,817	81,129
1946	89,801	170,930

*Texas Railroad Commission

TABLE 2—CARTHAGE WELLS AND CONNECTIONS AS OF MARCH 1, 1947

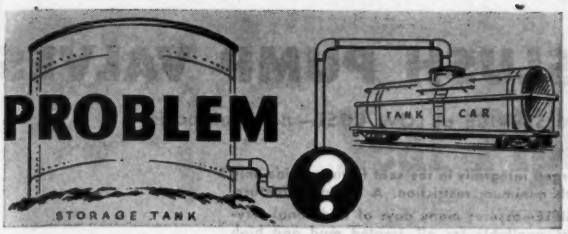
Gathering System	Hill	Upr. Pettit	Lwr. Pettit	Travis Peak	T'tl
Arkansas-Louisiana Gas Co.	6	15	27	..	48
The Chicago Corp.	..	35	36	..	71
Humble Oil & Refining Co.	..	4	13	..	17
Lone Star Producing Co.	..	17	4	5	25
Sun Oil Co.*	..	..	13	..	13
United Gas Pipe Line Co.	..	53	62	..	115
Miscellaneous†	17	16	16	..	49
Lease use	..	1	3	1	5
Unconnected	4	22	25	9	60
Total	27	163	199	15	404

*Connected to Chicago plant. †Field separation, gas to United Pipe Line.

TABLE 3—CURRENT PRORATED PRODUCTION*

Horizon	Allowable M.M.C.F./mo.	Per cent total	Avg. allowable well/day, M.M.C.F
Hill	942	8.0	1.3
Upper Pettit	5,627	48.0	1.3
Lower Pettit	5,102	43.5	.95
Travis Peak	39	.5	.21

*Not included; special emergency allowable extended through March.



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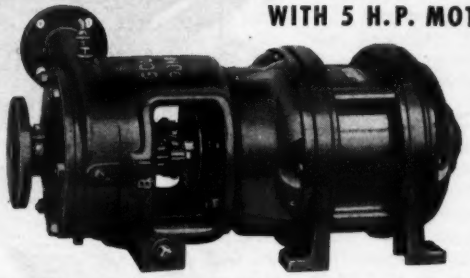

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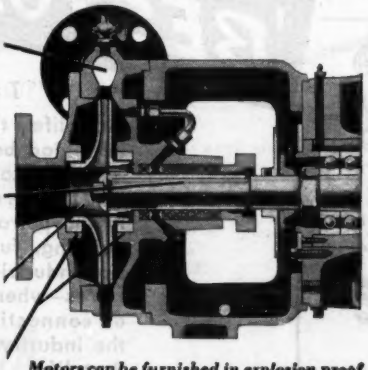

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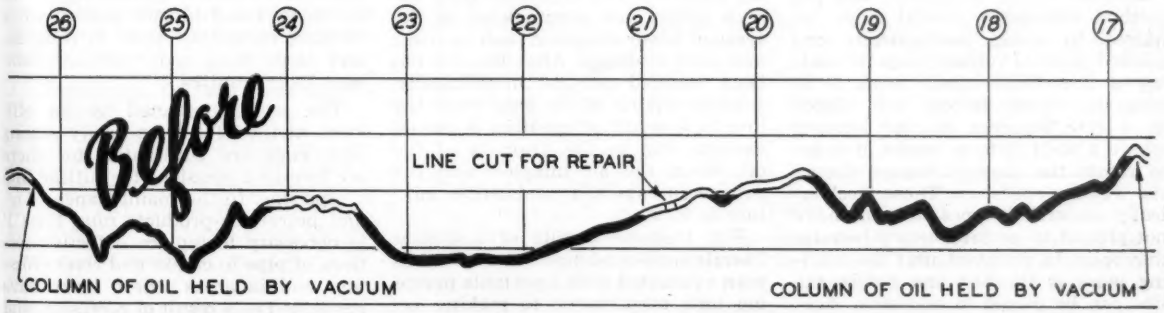
Pigs Seal Pipe Ends During Cutting Operations

by Paul Reed

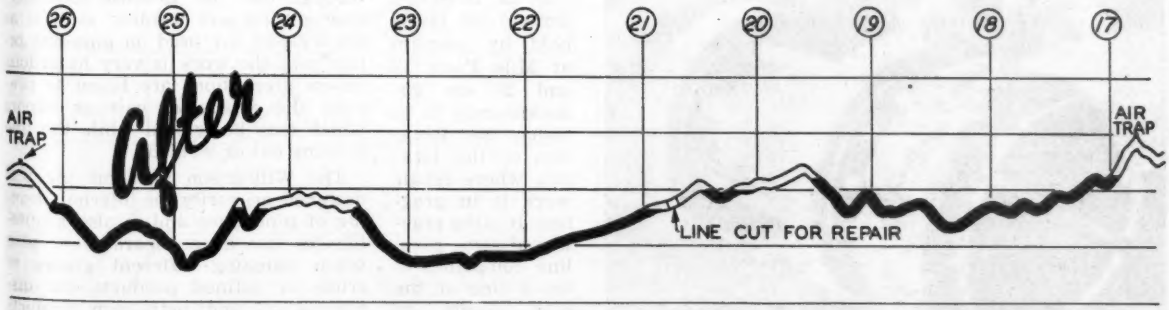
INSTEAD of using mud plugs, asphalt plugs, or special mechanically expanded plugs for stopping up the ends of pipe during cutting jobs, a pipe line company has been successfully using pigs of a type currently employed for routine internal-cleaning operations. These pigs can be readily inserted in the ends of the cut pipe. After welding has been completed, pumping is resumed and the two pigs are carried downstream by the fluid movement. Obviously this method, devised by a superintendent of line maintenance of one of the major pipe-line companies, eliminates much trouble encountered with the other methods commonly employed.

It has been a general practice of the pipe-line industry to plug pipe lines with earth, which is tamped into the open ends of the pipe adjacent to the location where a weld is to be made. This procedure has been used because a suitable mechanical seal has not been available. The use of the earthen plug is not entirely safe even though all of the fluid may have been disposed of; furthermore, operations at pump stations are often disrupted after completion of line-repair jobs because the earth used for plugging the line is carried into the station by the oil stream. The earth lodges in valves, pump suction lines, and in the valve chambers of the discharge pumps, which seriously restricts the flow of the stream through the pump. In many instances it has been necessary to shut down the entire station for cleaning the discharge pumps. In the larger-diameter pipe lines it is difficult to tamp the earth so as to make a satisfactory seal.

Since the pipe ends are stopped up by the Williamson type of pig, it is necessary to close with a cap the bypass or passage, through the body of the pigs, which is a feature of the design of this equipment. This capping is simply and easily done. Two pigs are required for these line-repair jobs: one is placed rear end first in the upstream end of the line adjacent to the location of the tie-in weld. Another pig is inserted into the line nose first, downstream from the other tie-in weld. The pipe is then cut and fitted with an oxyacetylene torch, placed in alignment, and arc welded. When the work is completed and the line placed in operation the pigs are moved forward by the stream to the scraper trap or other suitable facilities for removal.

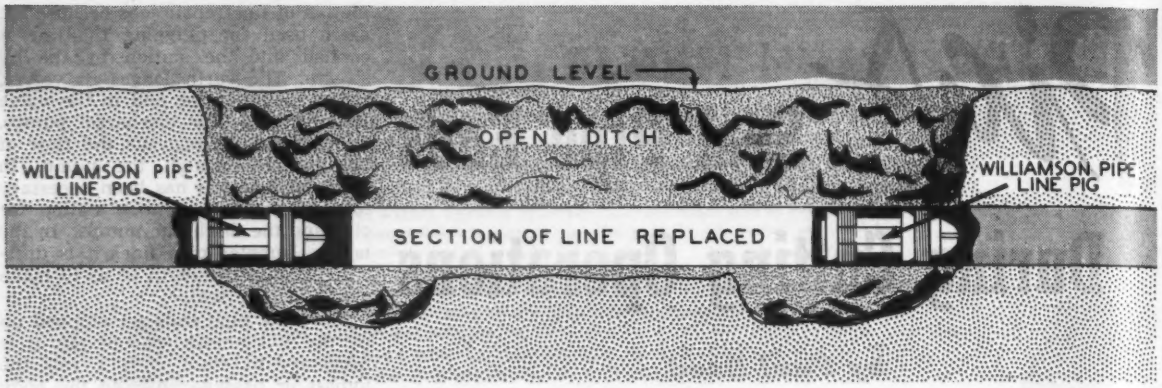


Profile showing typical section of pipe after evacuating oil with portable pumping unit on a major-company system. Note: Line has not been tapped at the high points to admit air. Vacuum is created at the high points by oil removed from line. This represents a hazard since the oil held in the line by vacuum is likely to escape while workmen are in process of cutting line or rewelding after repairs have been made



Profile shows typical section of line after evacuating oil with portable pumping unit. In this case the line has been tapped at both high points to admit air. This permits oil in the line to seek its natural level thereby reducing the hazard of cutting line and rewelding

Fig. 1—Cross-section of a major-company line showing how oil moved after vacuum was eliminated at high points in the line. Similar oil movements occur when the vacuum pockets are eliminated either by tapping the line to allow air to enter the high places or by an explosion at the location where the line is cut for repairs



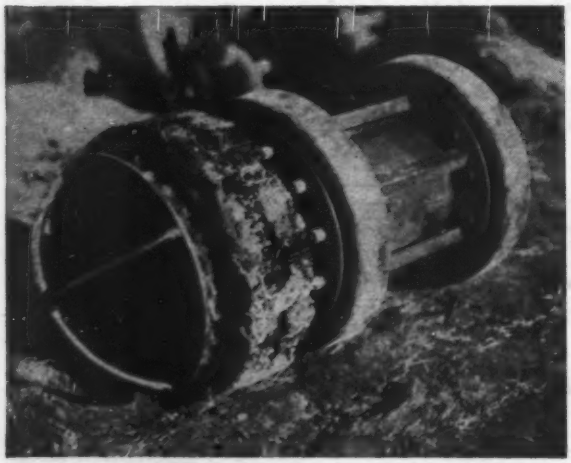
Position of pigs to seal line during cutting operations

It should be noted that, although the wire brushes and rubber cups on the pigs fit sufficiently tight to hold them firmly in the pipe and to make an effective seal for retaining the gaseous vapors, the pigs are not intended to seal off large volumes of oil or petroleum products trapped in the line. However, they may be expected to seal off fluid to meet requirements, for this is indicated by the fact that fluid pressure to move a pig ranges from 5 to 15 psi., depending on the size and condition of pipe line.

Because of its simplicity, this pig method eliminates several steps required in using mechanically expanded types of rubber plugs for sealing a line while repair work is in progress. Such devices are placed in a line adjacent to the location where a weld is to be made in order to retain the gaseous vapors during the welding operation. These mechanically expanded types of plug have not proved to be satisfactory because they must be removed after the welding work is finished and before the line can be placed in operation. Furthermore, a companion flange or other suitable coupling must be used for tying the line together after welding is completed.

The importance of effectively sealing pipe ends to insure safe operating conditions during pipe cutting jobs is apparent in considering the whole procedure. Preparatory to cutting the line mechanically it is generally evacuated with a portable pump. Where parallel pipe lines exist the pump is connected so as to transfer the oil from the defective line into another line which is in service. During the process of evacuation, air is admitted to the line while oil is being removed. The oil drains from the high points and accumulates in the areas of lower elevation such as creek and river crossings. After the line has been emptied and cut mechanically, a large volume of air may enter the line as a result of creating a partial vacuum due to the draining of the oil. When the air mingles with the petroleum vapors, a combustible mixture is formed.

Fig. 1 shows profile of a typical 10-mile section of pipe line which has been evacuated with a portable pumping unit preparatory to making repairs. It will be noted that oil has partially drained from the high points at Mile Posts 17, 24, and the high point beyond Mile Post 26; however, general oil levels held by vacuum at Mile Posts 17 and 26 are approximately 75 ft. above the elevation of the location where repair work is in progress. It is the practice of some pipe-line companies to tap a line at the high points on either side of the location where repair work is to be performed so that air may be admitted while the line is evacuated. This facilitates the work and reduces the possibility of an accident or fire after the line is cut at the location of the repair job.



One of two pigs utilized to seal ends of cut pipe

The bottom profile in Fig. 1 shows oil levels after air has been admitted at the high points.

If the line is not properly sealed before an acetylene cutting torch or a welding arc is applied, the gaseous vapors may ignite and the subsequent explosion is likely to release the oil or petroleum products held in the line by vacuum at the high points. There have been instances where the oil escaped and became ignited while welding operations were in progress, and large fires and excessive damages have resulted.

The savings effected by an efficient method for temporarily sealing pipe ends are substantial for there are frequent occasions for cutting into a pipe line. In the maintenance of oil and petroleum-products pipe lines it is necessary to replace defective sections of pipe in creeks and river crossings and in areas where leaks have developed as a result of corrosion, and for relocating sections of the lines to conform with highway construction or other improvements; also for cutting a line for the removal of obstructions which restrict the flow through the line. Because oxyacetylene cutting and welding as well as arc welding are used on pipe-line repair jobs the work is very hazardous unless precautions are taken to prevent the escape of gaseous vapors which may be ignited while the line is being cut or welded.

The Williamson pipe-line pig was designed primarily for internal cleaning of pipe lines and is also adaptable for use as a separator or plug when batching different grades of crude or refined products, for displacing oil and petroleum products with water, for displacing water with air, and for air swabbing pipe lines for removal of obstructions during construction periods as well as for the sealing operations when lines are cut.

ONE PRODUCING UNIT

OIL PRODUCTION by water

*by Park J. Jones**

PART 17 OF A SERIES

THE initial producing capacity of the L-1 reservoir (see Part 16) relative to one oil-water interface is only 7,000 bbl. per day. This rate is too slow. Practical considerations require that the initial rate of production be much faster. The faster rate is achieved by splitting the reservoir into three producing units. The factors which have to be considered in splitting reservoirs cannot be included within the space limitations of one article. So the splitting of the L-1 reservoir is started here but will be completed in Part 18.

Recoverable Oil

LET the porosity of the L-1 reservoir average 14.3 per cent and interstitial water, 30 per cent. For these conditions, an acre-foot of pay contains 777 bbl. of reservoir liquid. Let the volume factor be 1.11 bbl. per barrel of oil. Then the in-place oil averages 700 bbl. per acre-foot of pay and 133.3 million barrels for the reservoir.

Let the viscosity of water be 0.78 centipoises and that of the reservoir liquid, 3.5 centipoises. The corresponding fluid factor is equal to 1.11 (3.5)/0.78 or approximately 5. The recoverable oil averages (80 — 5) or 75 per cent of in-place oil or 525 bbl. per acre-foot of pay and about 100 million barrels for the reservoir.

Invaded Acre-Feet

The acre-feet of pay below a B contour in the L-1 reservoir is indicated by the B curve in Fig. 17-1. The position of the M contour is (B — 1,000C) downdip from the B contour. The acre-feet of pay below an M contour is given by the M curve in Fig. 17-1.

Cumulative Oil and Reservoir Capacity

The procedure used to estimate cumulative oil recovery for the L-1 reservoir produced at MER is itemized in Table 17-1. About 93.5 million barrels would be displaced when the oil-water interface advanced about 10,000 ft.

Cumulative recovery curve in Fig. 17-2 is through the points given in Table 17-1 except that about 3,000,000 bbl. were credited to expansion. The corresponding initial reservoir capacity is 7,000 bbl. per day. In the course of 50 years, reservoir capacity for an MER of 200 ft. per year declines down to about 2,000 bbl. per day.

The Rate of Depletion

Reservoir producing capacity Q is plotted against cumulative recovery C in Fig. 17-3. The L-1 reservoir has

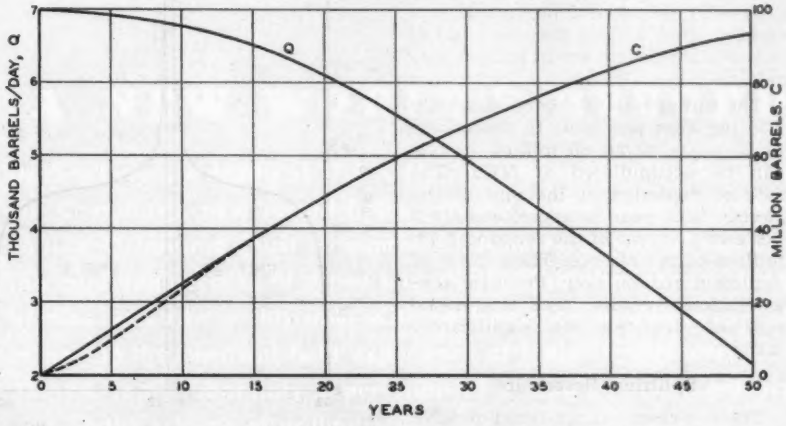
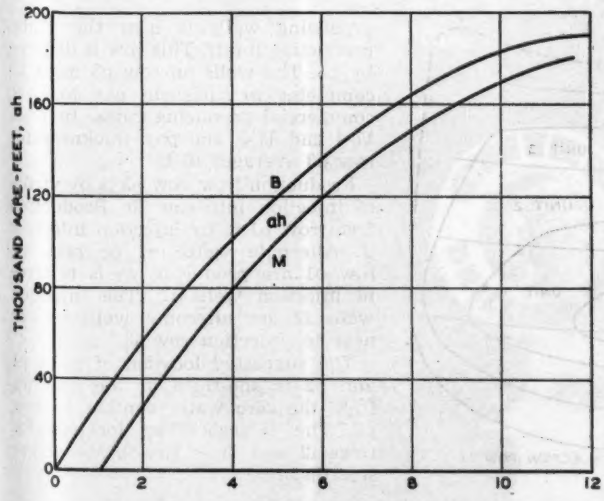


Fig. 17-2—Producing capacity Q and cumulative oil recovery C for L-1 reservoir produced at MER by one oil-water interface and 3,000,000 bbl. by expansion



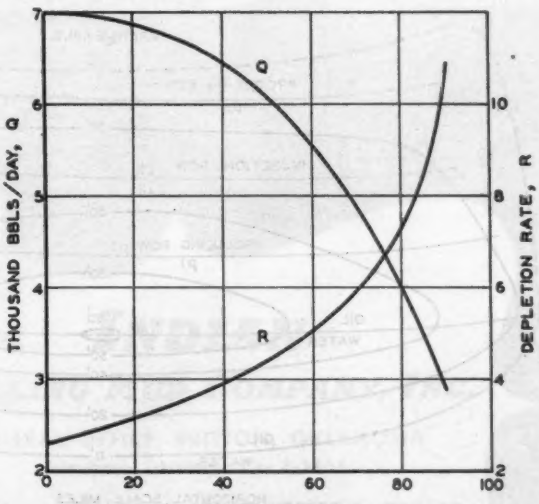


Fig. 17-1—(Left) Acre-feet of pay below B and M contours vs. distance advanced by B contour along top of pay in L-1 reservoir; position of M contour is (B — 1,000C) ft. downdip from B. Fig. 17-3—(Right) Producing capacity Q and depletion rate R in per cent per year of recoverable oil vs. cumulative oil recovery C for L-1 reservoir produced at MER by one oil-water interface and 3,000,000 bbl. by expansion

*Production consultant, Houston.

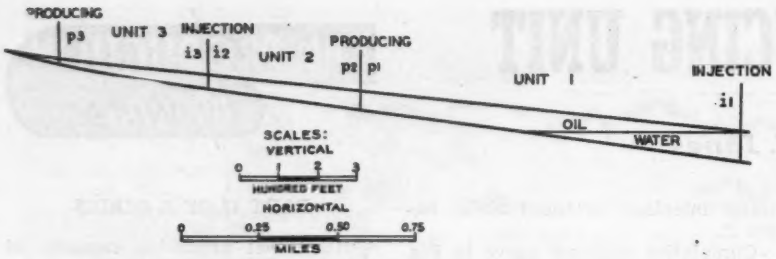


Fig. 17-4—N-S section through center of L-1 reservoir showing suggested locations of producing and injection rows for three producing units

190,460 acre-feet of pay. The recoverable oil aside from economic limits is 525 (190,460) or approximately 100 million barrels.

The rate of depletion is equal to the rate of production divided by reserve. The R curve in Fig. 17-3 shows the rate of depletion for the L-1 reservoir produced at MER by one oil-water interface. The rate of depletion in this example is equal to the annual producing rate divided by (100 — C) where the producing rate is in million barrels per year and C is cumulative recovery in million barrels.

The initial rate of depletion is only 2.55 per cent per year. In the course of 25 years, about 60 million barrels can be accumulated at MER. The rate of depletion at the end of the twenty-fifth year is approximately 5 per cent per year of the remaining 40-million-barrel reserve. These rates of depletion are too slow. Practical considerations require that the initial rate of depletion be significantly faster.

Splitting Reservoirs

The L-1 reservoir produced at MER by one oil-water interface has an excellent producing characteristic, namely, an increasing rate of depletion. But the absolute value of the depletion rate is too slow relative to any reasonable investment in producing and injection wells and any reasonable operating expense. The MER is much smaller than the optimum rate. Under such conditions the MER can be increased without exceeding the optimum rate.

The L-1 reservoir can be split into three producing units by drilling a row of injection wells other than those required along the water contact. A row of updip injection wells gives two additional oil-water interfaces.

Location of Rows

The problem in splitting reservoir is to locate producing and injection wells so as to minimize the production of water. There is no advantage in producing, say, 10 bbl. of water per barrel of oil if the oil can be recovered with, say, 2 bbl. of water.

Fig. 17-4 is an N-S section through the center of the L-1. The suggested location of producing and injection rows is indicated. Fig. 17-5 is a plan view of pay thickness and of the suggested location of the rows.

The optimum location for one row of injection wells is along the water contact. This row is denoted by il. The optimum location for one row of producing wells is near the updip productive limits. This row is denoted by p3. The wells on row p3 must be completed in sufficient pay to have commercial producing rates. In Figs. 17-4 and 17-5, the pay thickness for row p3 averages 10 ft.

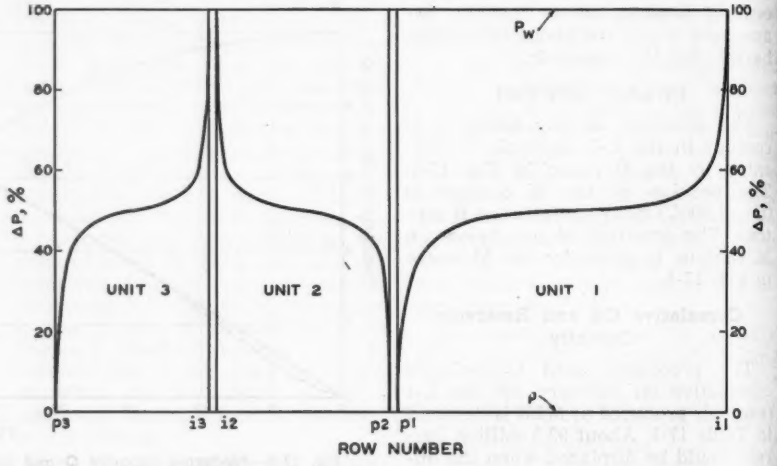


Fig. 17-6—Illustrating balanced bottom-hole pressures for L-1 reservoir: P_w is bottom-hole injection pressure; p is bottom-hole producing pressure

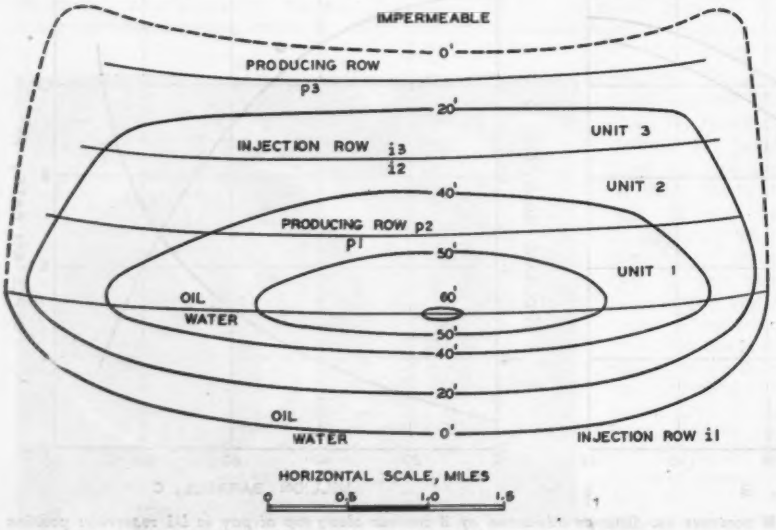


Fig. 17-5—Pay thickness and suggested location of producing and injection rows for three producing units on L-1 reservoir

Production from row p3 is by virtue of injection into row i3. Production from row p1 is by injection into row il. Alternate wells on, or near to, row p1 are producing wells relative to injection wells i2. The injection wells i2 are alternate wells on, or near to, injection row i3.

The suggested location of rows p1 and p2 is one-third of the distance from the zero water contour to row p3. The corresponding location for rows i2 and i3 is two-thirds of the said distance.

Operating Pressures

Aside from pressuring injected water, the bottom-hole injection pres-

(Continued on page 169)

DOWN TO A NEW WORLD'S RECORD

Drilling to record depths of 17,000 feet, as accomplished by Superior Oil Company's new record holder on the Weller lease in Caddo county, Oklahoma, must be *engineered*. And the service of consulting mud engineers is of prime importance. That the longest string of pipe was run in this hole with no formation trouble was due in part to the practical field experience of Indian's engineers and "on-the-spot" laboratory supervision of a mud treatment entirely new in the science of drilling.

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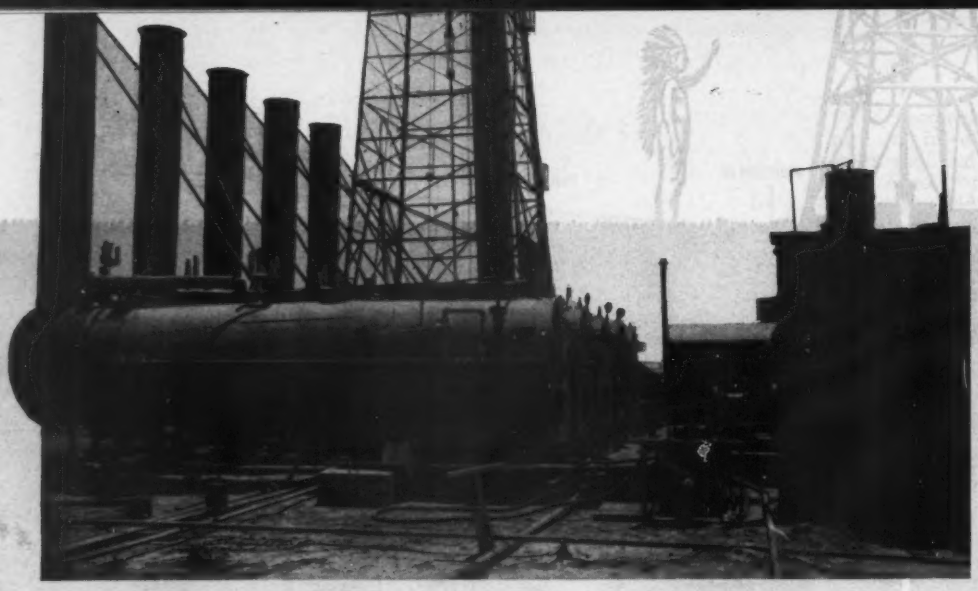
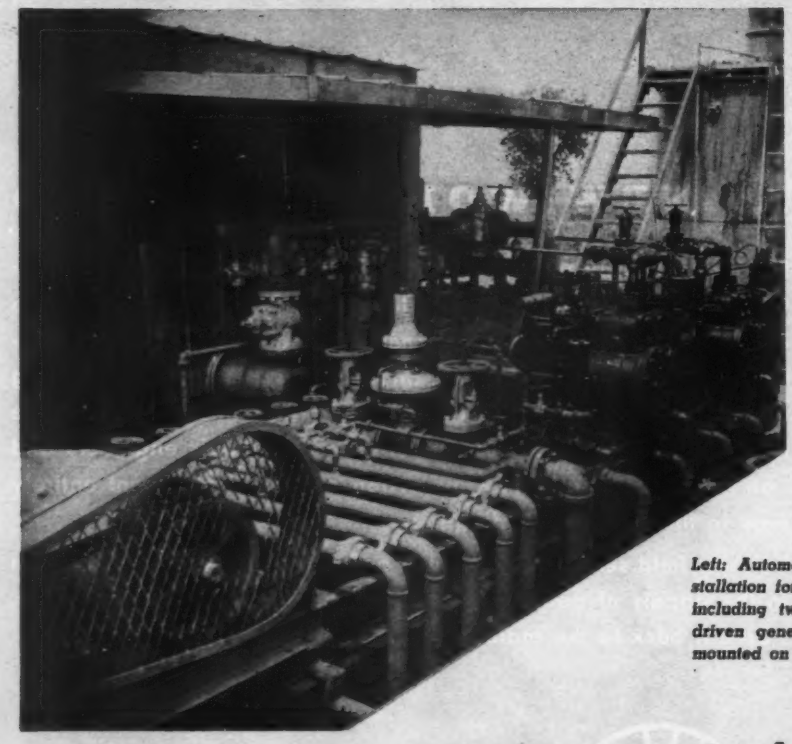


Steam for Superior's rig is supplied by five 135-hp., 350-psi.-working-pressure boilers equipped with automatic firing and water-feed controls. Tank at right is used for chemical treatment of feed water. Feed-water pumps and automatic control hookup are located behind tank. Pump in center foreground supplies water for general rig use



Drilling the World's

Left: Automatic feed-water and firing-control manifold installation for boilers (at right of picture). Entire assembly, including two feed-water pumps (rear) and two turbine-driven generators (partly visible at left), is permanently mounted on single skid unit. Below: Map showing location of well

Boiler installation as seen from top of feed-water treating tank showing automatic water-level control valves and alarms on front sides of boilers. Steam relief valves are shown on tops of boilers and on steam header at rear

's Deepest Well

by Neil Williams

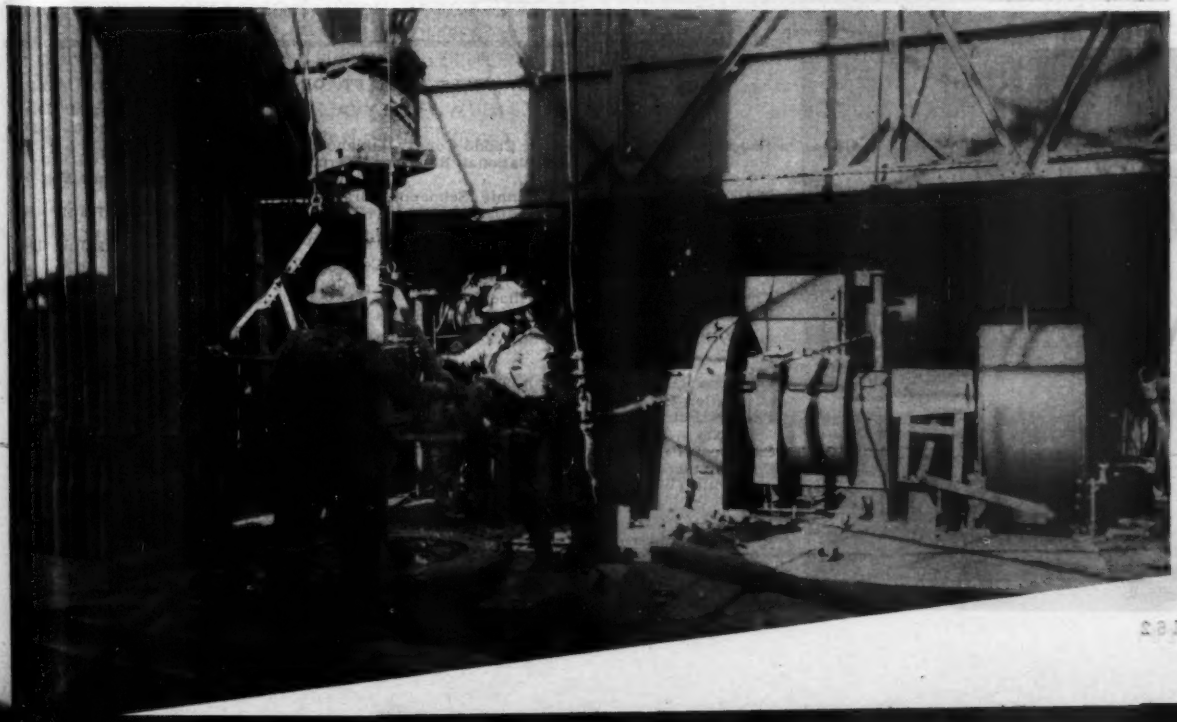
ACCOMPLISHMENTS of Superior Oil Co. of California in drilling the world's deepest test, its 51-11 Weller, located 5 miles north of Fort Cobb in Caddo County, western Oklahoma, demonstrate again the ability of the oil industry to provide the necessary equipment and devise appropriate methods and means when called upon to overcome the hazards of depth in search of additional petroleum reserves.

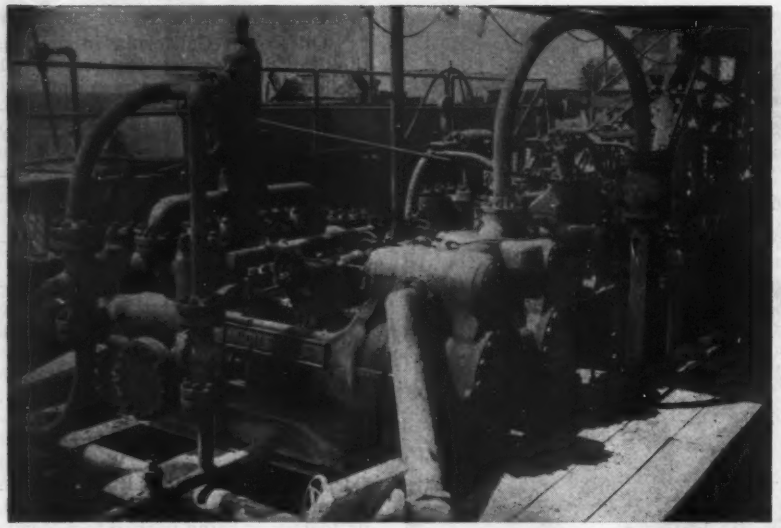
Exploring the deep potentially productive horizons within the Anadarko basin, Oklahoma's greatest remaining frontier for new development, this test on March 14 had reached a depth of 17,236 ft. On February 3, it equaled and passed the previous record depth of 16,668 ft. attained last November by Pacific Western Oil Corp. 1 National Royalties in Kern County, California. Drilling ahead, its footage is being pushed to a steadily increasing record for future wells to "shoot" at.

In addition to being the deepest hole in the world, this test has a number of other important records to its credit, among them being:

1. The longest string of casing of any size ever run, this being a string of 7-in. pipe of combination weights set and cemented at 16,351 ft. (measured from the top of the casing head).
2. The second longest and heaviest string of 9⅝-in. casing, which was set and cemented at 10,240 ft. (measured from the top of the casing head).
3. The greatest amount of open hole ever carried. This was drilled

Below: Breaking kelly connection on trip out of hole after breaking world's depth record. On this trip, the kelly was made up and the hole circulated each time after pulling several stands of pipe. This accounts for the kelly being on the string during the trip





Mud-circulating pumps located below auxiliary draw works and engine floor. Installation includes one 18 by 7 by 20-in. triplex pump (foreground) and two 15½ by 8½ by 20-in. duplex pumps. Additional 14 by 7½ by 14-in. duplex pump (not shown) is provided

Left: Daylight-tour crew: J. B. Short (driller), A. L. Smithpeter, Charlie Reese, W. G. Cooper (fireman), C. W. Hill, Neff Bower, and R. L. Calvert. Bottom, left: J. B. Short, driller on day tour, watches his instrument panel as he eases off the load while running pipe in the hole

with 12¼-in. bits from the bottom of the 13⅜-in. surface casing to 10,317 ft.; a total of 8,777 ft.

4. The deepest drill-stem tests ever made, two such tests being made below the bottom of the 7-in. casing at 16,351 ft. to test the effectiveness of cement and casing shutoff.

5. The deepest successful fishing job, this involving recovery of a twistoff at a depth below 16,000 ft.

Drilling was started April 4, 1946, and considering the hard formations and other hazards encountered and numerous twistoffs, the hole has been carried to its present depth in unusually short time. It can be said, however, that the twistoffs, although numerous, did not result in any serious trouble. In every instance, the fish was recovered on the first run with an overshot, a credit to the efficiency of the operators and the good condition of the hole. The fast drilling time reflects the special precautions always taken by this company in the way of provision of adequate equipment, abundant power, and emergency facilities to avoid or minimize shutdowns and lost time because of mechanical failures, and the adoption of practices designed to maintain the hole in such shape that formational trouble will be prevented. Never has the hole been much more than 1° off vertical.

Hole for the 13⅜-in. surface casing, set and cemented at 1,540 ft., was drilled with 15½-in. bits and reamed to 17 in. Surface casing was made up of 54.50 and 61-lb. J-55 grade pipe and cemented to the surface

DEEP WELLS (15,000 FT. OR DEEPER)

Well and location—	Depth (ft.)	Status and date reached total depth
Superior Oil Co. 51-11 Weller, Caddo County, Oklahoma	17,236	March 4
Pacific Western Oil Co. 1 National Royalties, Kern County, California	16,668	Fishing since Feb. 1946
Phillips Petroleum Co. 3 Fannie Schoeppe, Brazos County, Texas	16,655	Abandoned July 1944
Standard Oil Co. of California 20-13 KCL, Kern County, California (South Coles Levee field)	16,246	Abandoned July 1943
Superior Oil Co. 1 Cassie Bradford, Forrest County, Mississippi	15,726	SDWO January 1947
The Texas Co. 6 Yturria, Willacy County	15,560	Drilling
Humble Oil & Refining Co. 10 E. F. Milo, Harris County, Texas (Tomball field)	15,452	Plugged back and completed in field sands, December 1945.
Quintana Oil Co. 3-D South Texas Syndicate, McMullen County, Texas	15,301	Abandoned Feb. 1945
Phillips Petroleum Co. 1 Ada Price, Pecos County, Texas	15,279	Abandoned May 1944
Caribbean Petroleum Co. 2-A Curacao, Zulia, Venezuela	15,106	Abandoned Sept. 1946
Continental Oil Co. A-2 KCL, Kern County, California (Wasco field)	15,004	Plugged back, completed shallow sands, April 1938.

Twenty-three additional wells have been drilled to depth of 14,000 to 15,000 ft.

Congratulations

to Superior Oil Company of Calif.

DRILLING the world's deepest test well is an outstanding achievement. We take pride in having participated as water engineers on this well. As a matter of record, we have furnished this Company our water engineering service and chemicals for boilers since late 1944, when this rig was first brought into Oklahoma. Because of our central location, we are able to give personal service to our clients in Kansas, Oklahoma and Texas. Our operations include problems of heat exchange or refrigeration, which are accomplished by the use of water.

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Perfect vibrating motion . . . Even feed distribution . . . The proven product of 25 years experience in designing vibrating Screen Equipment.

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San Francisco, California

Petroleum Machinery Corp.
30 Rockefeller Plaza
New York, New York

Mud-return side of rig showing steel mud tanks and shale-shaker hookup (right) and 1,000-bbl. steel mud-reserve tank (left). Chemical feed box is mounted on elevated platform above steel mud-return ditch by steps to side entrance to derrick floor. Partly visible on ground level back of mud tank below chemical feed tank is mud-mixing pump, with mud-mixing pit back of water pit (foreground)

using approximately 1,200 sacks of cement. Under this, 12½-in. hole was drilled to 10,317 ft., and the 9⅝-in. secondary casing string set at 10,240 ft. Cementing took a total of 2,500 sacks, consisting of 1,220 sacks of slowset and 1,280 sacks of regular bulk cement. The casing in this case consisted of N-80 grade Spang-Chalfant extreme line pipe made up in the order run of the following weights: 76 lengths of 53.50 lb. pipe, 164 lengths of 47-lb. pipe, and 16 lengths of 53.50-lb. pipe. Total weight of the string was 506,820 lb., a record for strings of that size. No difficulty was encountered. The string was landed and the plug down on August 21, 139 days after drilling was started. The only other string of casing of this size that has been run to this or greater depths was set in a well drilled by Humble Oil & Refining Co. in Lafourche Parish, Louisiana Gulf Coast, in 1940. The latter string, also 9⅝-in. casing totaled 10,907 ft.

The long string of 7-in. casing, set at a depth of 16,351 ft. from the top of the casing head, was run in 8¾-in. hole, which allowed an extremely close clearance. The fact that the string went down without any trouble attested to the straightness and good condition of the hole. To drill hole of that offsize it was necessary to have the bits specially made. For this, 8½-in. bits were ground down to the 8¾-in. specifications.

Grade N-80 Range 3 (40-44-ft. lengths) Spang-Chalfant extreme line pipe was used so that the maximum outside diameter of the string was reduced to a minimum. Because of high tension and compression factors involved in a string of casing that long, special consideration had to be given to the selection of pipe weights, use of the proper amount of pipe of different weights, and the correct placement and distribution of the weight in the string. The weights, amount of pipe of each weight and makeup of the string from bottom up follows:

Footage (ft.)	Pipe weight (lb./ft.)	Total weight (lb.)
5,835	38	221,730
1,901	35	66,535
7,623	32	243,936
934	35	32,690
58	38	2,204
16,351		567,095

Measuring from the top of the rotary table, an additional 10 ft. of casing actually was run, as usually computed, making the top section of 38-lb. pipe 68 ft. instead of the 58 ft. shown in the above tabulation. With this extra length and considering the extra weight at the threaded points, the actual weight of the pipe run totaled 294 tons (588,000 lb.). However, the operators have computed their measurements from the top of casing head, where the pipe was cut off, and the string welded into the head.

Inspection Procedure

All pipe was tested at the mill to 5,000 psi. bursting pressure, and at the location all joints were Tuboscope inspected for possible imperfections. However, not a joint had to be rejected as a result of the inspection. Because of the amount of pipe and desire to avoid as much delay as possible, three testing units, one brought from Houston, another from Odessa, and the third from Oklahoma City, were operated simultaneously, completing the job in less than 2 days.

As a further precaution gainst possible trouble and to insure perfect makeup, threads of each joint, as run, were thoroughly cleaned, inspected, and regreased with an aluminum-soap-base graphite (National Supply 450 thread lubricant). Each joint was checked with 0.0015 feeler gage for shoulder makeup. All joints were shouldered uniformly with five to six wraps on the cathead, plus three to five jerks on the tongs. As each joint was run in, it was filled with mud as protection against a possible blowout and to aid in getting the pipe to bottom. During the operation, all drill pipe was left standing in the derrick instead of being laid down on the rack so that it would be ready to run into the hole quickly in the event of a threatened blowout.

Twelve lines were strung to handle the load. A casing shoe was welded on the bottom of the string, and two float collars were welded in the string, one on the first joint and the other on the second. The shoe was started in the hole at 2:30 p.m. January 1 and was on bottom at 5:45 p.m. January 2, an elapsed running time of 27¼ hours. No attempt was made to break any time records. Throughout, speed was sacrificed for safety and insurance of a successful and perfect job. Normally, this type of pipe, in which, not using collars, threaded connections are reduced 50 per cent, can be run at the rate of from 1,000 to 1,500 ft. per hour. In this case, not only was extra time taken to make certain the pipe was in perfect shape and made up properly, but the string was run during the severest cold weather of the winter with temperature around zero, and under extremely hazardous conditions which slowed up the work.

This string was cemented with approximately 650 sacks of slow-set cement handled in bulk form. In

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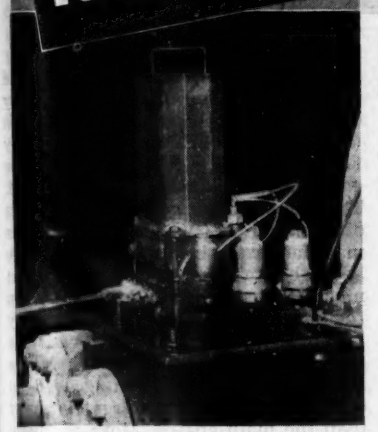

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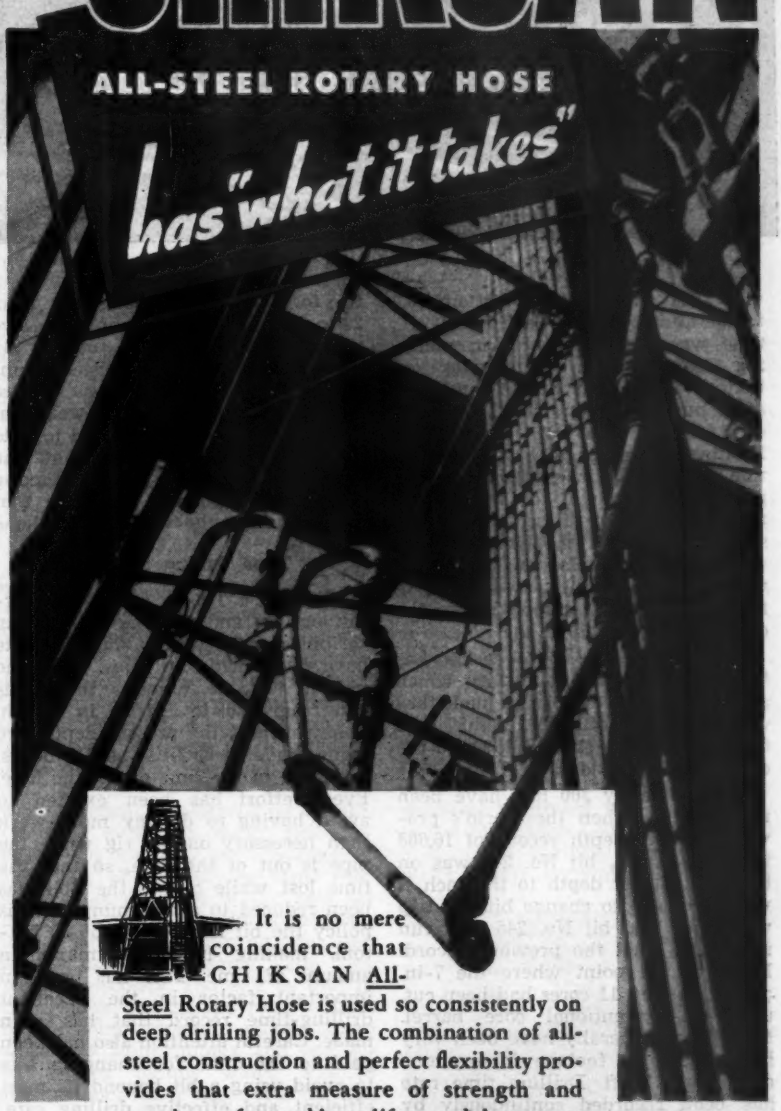

It is no mere coincidence that CHIKSAN All-Steel Rotary Hose is used so consistently on deep drilling jobs. The combination of all-steel construction and perfect flexibility provides that extra measure of strength and stamina, safety and long life...and that means greater protection for the crew, the equipment and the well itself. Operating records prove CHIKSAN All-Steel Rotary Hose also costs less per foot of hole drilled.

Unretouched photo of CHIKSAN All-Steel Rotary Hose on the world's deepest well . . . Fort Cobb, Oklahoma • Drilled by Superior Oil Co.

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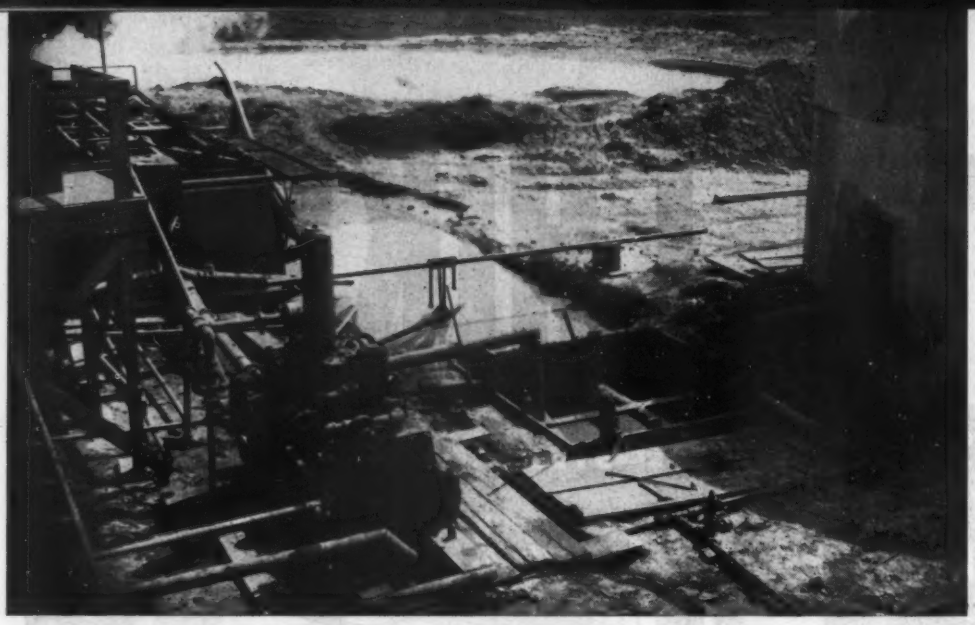


Mud-mixing installation as viewed from back corner of elevated main engine floor. Mixing pump (foreground) is hooked up to take suction either from small mixing pit (center foreground), water pit (back of mixing pit), or bottom of circulating tank (left). It discharges through manifold (left of pump) either to 1,000-bbl. mud-storage tank (right), mud tanks, or direct to mud-return ditch

view of the high bottom-hole temperature, 360° F. at 16,351 ft., time was a major factor in pumping the cement. Plug was on bottom in 1 hour and 14 minutes after pumping was started. Pressure of 3,600 psi. was built up on the Halliburton pumps to break circulation. Cementing trucks from various places were brought to the well for the job. One of these, the largest steam unit which the company has, was brought from Houston. No chance was taken that there would be a failure or slightest stoppage once the cement was started in the hole.

Hole below the 7-in. casing has been drilled with 5¾-in. bits, which also have been specially made because of their offsize. In this case 5⅞-in. bits were ground down to the desired specifications.

Approximately 300 bits have been used so far. When the world's previous drilling depth record of 16,668 ft. was equaled, bit No. 244 was on bottom. At that depth to the inch it was necessary to change bits. A trip was made and bit No. 245 was run in to drill past the previous record. Down to the point where the 7-in. casing was set, 11 cores had been cut, using a conventional core barrel. Formations generally have been very hard, the most footage in any one day being 120 ft. Drilling time rate has been recorded continuously by means of a Geolograph.

Drilling has been done with Grade E Range 3 Spang seamless external upset, internal flush plastic-coated drill pipe with external upset tool joints. Down to 15,000 ft. 4½-in. 18.10 lb. pipe was used. Below 15,000 ft., this pipe was replaced with 3½-in. 15.50-lb. pipe. Replacement was accomplished gradually to avoid having to stay out of the hole too long on any one trip, which would have been necessitated if the entire string had been replaced at one time. The practice followed was to changeover from 20 to 25 joints at a time on successive trips. Seven drill collars, totaling 219 ft., have been used consistently for the entire hole with a view toward applying and concentrating weight at the bit. In this, it was desired to hold as much weight as practical off the drill pipe and thus prevent flexing the pipe and possible whipping that might damage the walls of the hole.

Time Saving in Trips

Utilizing a 176-ft. derrick to permit pulling and running the pipe in thribbles, important savings of time have been made on trips. With the pipe in 40 to 44 ft. joints, the stands run from 120 to 132 ft. in length. Trips, even at the present depth, are being made in as little as 6½ hours, exclusive of the time out of the hole. Every effort has been exerted to avoid having to do any more work than necessary on the rig while the pipe is out of the hole, so that the time lost while out of the hole has been reduced to a minimum. By this policy the bit has been kept on bottom, making hole the maximum amount of time. This has been an important factor in the excellent drilling-time record that has been made. Careful attention also has been paid to the time for changing bits to avoid using a bit beyond its most efficient and effective drilling rate. From the beginning, a seven-man crew has been worked, using two men in the derrick for trips, and a full-time boiler man.

Eight lines, using 1¼-in. wire line, have been strung for all drilling operations, except for running the long strings of casing. Blocks being used are the largest and heaviest currently available. The crown has seven sheaves and is rated at 600 tons. The traveling block is rated at 500 tons. The rig has two draw works located on opposite sides of the floor, one for regular service and the other for auxiliary or standby duty. Both are the same size and type (National 23-9 FEC model with 9 by 11½-in. drum shaft) and can replace each other for most any service. These are not the largest draw works of their kind (two larger sizes are manufactured) but so far they have been able to handle the loads without much difficulty. The draw works in regular use is powered by a 14 by 14-in. steam engine. However, the drive of 12 by 12-in. engine on the standby hoist has been geared to deliver as much if not greater power than the main engine. More adequate braking capacity is provided on the main draw works, however, by the installation of a recently designed dynamatic (electrically operated) brake. This unit, which in effect is a large electric motor operating in reverse on the loads, was installed October 15, and has been an important factor in the ability of the rig to handle the heavy loads. Consequently, the principal function of the auxiliary draw works at present is for pulling over the line to change wearing position, although it is readily available for emergency use with its engine also being used as a drive for sand-line reel.

To save the draw-works drive and engines for exclusive hoisting duty and also to give more working space on the 32-ft. square derrick floor, the rotary is independently driven from a separate 12 by 12-in. steam engine located on the ground level below the floor. The rotary is a 20½-in. size, measuring 53¼-in. from the center of the table to the center of the sprocket.

Much of the success in maintaining the hole in good condition is attributed to effective drilling-mud control. An entirely new method of mud treatment has been followed, employing chemicals never before used.

How the mud was treated and the chemicals used are treated in a separate article in this issue. In the treatment, and with the use only of the bentonite and the special chemicals, water loss of the mud has been held to a maximum of 5 cc., thus reducing the chance of water infiltration and building up of filter cake to a minimum. Relatively high viscosity has been carried, running as high as 200 seconds at times although generally it has been around 75 seconds. In the present hole, weight has been maintained around 11 lb. per gallon. Drilling-mud service has been supplied by Indian Drilling Mud Co. of Oklahoma City.

Three mud pumps are available at all times for regular mud circulation providing more than adequate volume and pressure capacity. Included are an 18 by 7 by 20-in. triplex pump and two 15½ by 8½ by 20-in. duplex pumps. Normally only one of the duplex pumps having a maximum discharge pressure of 2,300 psi. has been needed, but all are tied into the system so that any or all of them can be operated in any combination to meet any emergency. An additional 14 by 7½ by 14-in. pump is provided for mud mixing and other auxiliary and circulatory duty.

To insure uninterrupted mud circulation in the event of a mechanical break during an emergency a dual mud-line hookup has been provided. Should one line break, circulation can quickly be directed to the other. The two mud lines from the pump discharge are manifolded to the two standpipes so that either standpipe can be used in either hookup. One standpipe has a 3-in. by 55-ft. steel rotary hose connection to the swivel while the other has a 3-in. by 55-ft. conventional rubber rotary hose.

Steel mud tanks, one 28 by 5½ by 8 ft. and the other 26 by 5½ by 8 ft. in size, are used for mud return and suction pits. An additional 1,000-bbl. tank provides reserve and storage. This is kept full ready for use if needed. Included in the system are steel mud ditches and two shale shakers, all of which are unitized with steel mud tanks.

Drilling-control hookup includes two blowout preventers. One is a 23,000-psi. test assembly. To accommodate this assembly, an 11-ft. substructure is provided for the derrick. The substructure is an integral part of the derrick, being built into the extended derrick legs. With the substructure the over-all height of the 176-ft. derrick to the top of the gin pole is 202 ft. The structure, including engine substructure, is supported on a solid concrete slab.

Five 130-hp. 350-psi. working-pressure boilers meet the heavy steam requirements for the various drilling operations. These are equipped with automatic firing, water level, and blower controls insuring automatic maintenance of full steam pressure at all times and maximum safety in operations. Combination oil-gas burners are installed. To insure continuous adequate fuel supply, both gas and oil are used. Gas is supplied by a 9-mile line laid from a main transmission line. In addition, a 1,000-bbl. fuel oil tank is provided at the location. Operation of the burners is such that when the gas pressure drops below requirements to maintain steam pressure, the oil supply automatically cuts in to fill the deficiency. Approximately 1,000,000 cu. ft. of gas daily is required. Water supply is obtained from three shallow sand wells equipped with small individual pumping units powered by internal-combustion engines. The water is pumped to two 1,000-bbl. storage tanks from which it is fed to a 500-bbl. chemical treating tank for suction to the two boiler-feed pumps.

Electric power for shale-shaker motors, lighting, and operation of the dynamatic brake on the draw works is furnished by two steam-turbine-driven 10-kw. 124-volt d.c. generators, one a standby.

The rig is one which originally was assembled in 1938 and which previously has been operated both in California for a number of years and later in Wyoming. It was moved to Oklahoma about 2 years ago. The present test is the second for it in the latter state, the first being drilled near Okeene in Blaine County in 1945.[1] While much of the major part of the rig is old and some of the equipment not as large as that on many of the newer deep-drilling rigs, it has been thoroughly maintained, modernized, and some of the older equipment replaced with newer and larger parts.

The present test is being drilled in an almost solid block of about 20,000 acres. Operations have been supervised directly by Laymon Corley, drilling superintendent at Fort Cobb, and J. C. Cody, general superintendent, Bakersfield, Calif.

References

1. Williams, Neil: Special Mechanical Safeguards Installed on Deep-Drilling Rig. The Oil and Gas Journal, September 8, 1945, page 86.

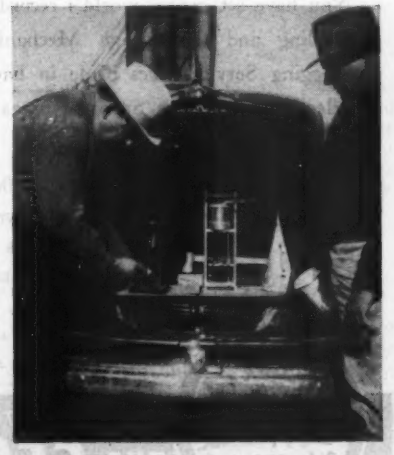
Unusual Mud Problems Encountered

by R. M. Ross* and W. L. Potter†

THE 51-11 Weller presented a number of problems that had never been encountered before in Oklahoma or in the Mid-Continent area. To drill a deep hole no one could ask for a better setup than Superior had on this location. Mud was carried in two 300-bbl. tanks. All jetting was done with water, meaning that the mud system was never spotty and was consistent throughout on weight, viscosity, gels, and water loss. Superior was ready for any contingency; 1,000 bbl. of mud of the same consistency as the mud in the hole sat in the reserve tank for immediate use. A separate mixing pit was used to mix mud to the same water loss, weight, viscosity, and gels as that in the system and in the reserve tank before being added to either. There were two 20-in. duplex and one 20-in. triplex pumps which enabled maintenance of a high velocity and adequate pump pressure and volume at all times.

A thorough study was made of the mud programs that were instigated by all mud companies operating in the Anadarko basin. We knew that it would be necessary to make a radical change from any of the chemical treatments that had been used heretofore. There was no starch or other additives used in this mud system at any time. A water loss of around 20 cc. was carried through the Permian red bed section and was progressively lowered to under 6 cc. as the thicker shale sections were reached.

We found it necessary to use an altogether different chemical program due to the fact that water contamination presented problems not ordinarily encountered in the Mid-Continent area. To ascertain the proper chemical treatment it was necessary to run more than 1,000 pilot tests and a thorough analysis of the makeup water before arriving at the proper



R. M. Ross and W. L. Potter, of Indian Drilling Mud Co., working with testing equipment on back of service car

*President and †vice president, Indian Drilling Mud Co., Inc., Britton, Okla.

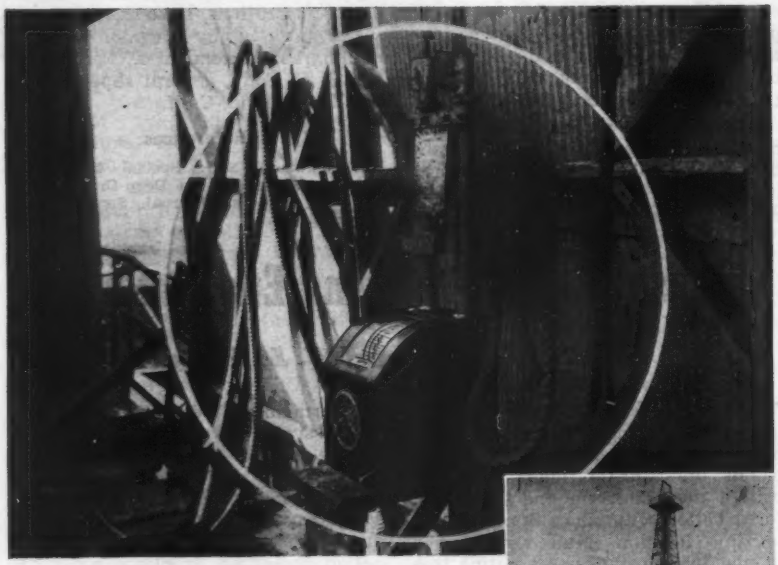
chemical combination to carry on this hole. We exhausted all the known methods of tracing the conditions in the makeup water a system of trial and error and elimination of all possible factors enabled us to work out the chemical treatment.

There was a large number of drill collars run in this hole and on the fishing jobs every fish was caught and pulled on the first run with no difficulty whatsoever. This was due to the careful watch that was kept on the thixotropic qualities of the bentonite mud.

One of the greatest contributing factors to the success of drilling this deep well was the cooperation of Superior's entire personnel.

Equipment Used in Drilling Well

Draw works, 23-9FEC, 9 by 11½-in. shaft (2)—National Supply Co.
Draw-works engines (14 by 14-in. and 12 by 12-in. Ajax Ideal)—National Supply Co.
Rotary (H-S 20½-in. Ideal)—National Supply Co.
Rotary engine (12 by 12-in. Ajax Ideal)—National Supply Co.
Crown block (600-ton)—Regan Forge & Engineering Co.
Traveling block (500-ton)—Regan Forge & Engineering Co.
Derrick (176 by 32-ft.)—Emsco Derrick & Equipment Co.
Finger board (23-ft.)—MacClatchie Manufacturing Co.
Substructures (11-ft.)—Steel Oil Derrick Co.
Drilling lines (1¼-in.)—John A. Roebling's Sons Co.
Sand reel—National Supply Co.
Chains—National Supply Co.
Swivel (Ideal Type M)—National Supply Co.
Connector (DA-30 Ideal)—National Supply Co.
Rotary hose, steel 5-in. by 55-ft.—Chicksan Co.
Rotary hose, rubber—Mankgranander.
Rotary hose, rubber (Grizzley)—F. M. Smith Co.
Cathead—Foster Cathead Co.
Supplementary brake (electric)—Dynamatic Corp.
Brake electric control—Pyle-National.
Slips (Varco)—Abegg & Reinhold Co.
Power slips—Byron Jackson Co.
Tongs—Byron Jackson Co.
Elevators—Web Wilson Oil Tools.
Instruments—Martin Decker Corp.
Drill pipe (4½-in. 18.10-lb.-3½-in. 15.5-lb.)—Spang-Chalfant division, National Supply Co.
Drill collars—Baash-Ross Tool Co.
Kelly—National Supply Co.
Kelly bushing (Varco)—Abegg & Reinhold Co.
Bits—Hughes Tool Co.
Core barrels—Hughes Tool Co.
Fishing tools—S. R. Bowen Co.
Blowout preventers—Shaffer Tool Works, Cameron Iron Works, Hydril Co.
Casing head—Oil Center Tool Co.
Casing—Spang-Chalfant division, National Supply Co.
Casing shoes and float collars—Baker Oil Tools, Inc.
Pipe protectors—Patterson-Ballagh Corp.
Pipe inspection—Tuboscope.
Cementing—Halliburton Oil Well Cementing Co.
Drilling-mud service—Indian Drilling Mud Co.
Drilling mud—Mobar Corp.
Mud pump—One 18 by 7 by 20-in. triplex—Oil Well Supply Co.
Mud pump—Two 15½ by 8½ by 20-in. Ideal duplex—National Supply Co.
Mud pump—One 14 by 7¼ by 14-in. Ideal duplex (mixing)—National Supply Co.
Mud circulating tanks—Steel Oil Derrick Co.
Lubricators (pumps)—McCord Radiator & Manufacturing Co.
Shale shakers (2)—Overstrom & Sons.
Shale shakers (1)—Link Belt Co.
Shale-shaker motors—General Electric Co.
Mud saver—Mid-Continent Supply Co.
Drilling-time recorder—The Geolograph Co.
Air compressor—Westinghouse.
Steam scrubber (Master)—W-K-M Co.
Boilers (five 135-hp., 350-psi. working pressure)—Broderick Boiler Co.
Burners (combination oil-gas)—Bullum.
Automatic firing control—Inferno Co.
Automatic water-feed regulators—Wilgus.
Water-level control and alarm—Reliance Gauge Column Co.
Water-level steam-valve control—Pinkerton.
Water-level gage (sight glasses)—Edna Water Level Gage Co.
Pressure gages—Ashcroft.
Water-treating chemical—Solvent Manufacturing Co.
Valves—Lunkenheimer Co., Crane Co., Nordstrom Valve Co., Edwards Valve Co.
Generators (two 10-kw. 125-volt)—Century Electric Co.
Generator steam turbines (2)—Turbolite, Inc.
Lighting electrical appliances—Mongerson Electric Machine Works.
Auxiliary generator unit—Koehler.
Boiler-feed water pumps (three 10 by 5 by 10-in.)—National Supply Co.
Tankage (four 1,000-bbl. steel tanks)—Black, Sivalls & Bryson, Inc.
Water-well pumping units—National Supply Co.
Pumping-unit engines—Waukesha Motor Co.
Cement—Missouri Portland slow-set; Arkansas Portland slow-set; OK Portland regular.



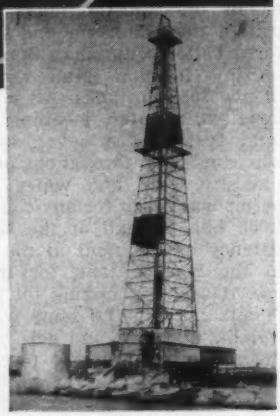


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TABLE 17-1—CUMULATIVE OIL RECOVERY FROM THE L-1 RESERVOIR

Thousand feet for B	0.25	0.5	0.75	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Thousand acre-feet for B	8	15	22	29	55	80	101	119	135	150	164	175	183
Thousand acre-feet for M	...	...	...	...	28	54	78	99	117	133	148	160	169
Thousand acre-feet for (B—M)	8	15	22	29	27	26	23	20	18	17	16	15	14
Barrels per acre-foot for B—M	200	250	290	340	...	...	...	...	...	...	...	...	340
Million barrels for (B—M)	1.6	3.8	6.4	9.9	9.2	8.8	7.8	6.8	6.1	5.8	5.4	5.1	4.8
Million barrels for M*	...	...	...	...	14.7	28.4	41.0	52.0	61.4	69.8	77.7	84.0	88.7
Cumulative recovery, million barrels	1.6	3.8	6.4	9.9	23.9	37.2	48.8	58.8	67.4	75.6	83.1	89.1	93.5

*At 525 bbl. per acre-foot.

One Producing Unit

(Continued from page 148)

sure P_w is approximately the same for rows i1, i2 and i3. This is indicated by the 100 per cent line in Fig. 17-6.

The bottom-hole producing pressure p is approximately uniform for the wells on rows p1, p2 and p3. This is indicated by the zero per cent line in Fig. 17-6.

The pressure difference between injection and producing wells is $(P_w - p)$. Let P denote the reservoir pressure. Other things equal, the ratio of pressure buildup $(P_w - P)$ to pressure drawdown $(P - p)$ depends on the ratio of injection to producing wells for a given unit. The pressure in Unit 1 is not necessarily the same as in Units 2 or 3. However, the pressure differences $(P_w - p)$ are the same for all three units. This assumption is for illustrative purposes only.

Unit No. 1

The initial producing rate for row p1 is 7,000 bbl. per day. The corresponding rate of water injection into row i1 is 7,000 (1.11) or 7,800 bbl. per day aside from encroaching water.

The distance from the zero-water contour up to row p1 is about ½ mile. A life of about 15 years is indicated before row p1 starts producing large quantities of water. The MER for Unit 1 during the fifteenth year is about 6,500 bbl. of oil per day. Accordingly, the load on the p1 wells will average between 7,000 and 6,500 bbl. aside from water in production.

The load on the i1 injection wells will average between 7,800 and 7,200 bbl. of water per day. But with production of water from p1, the injection load will increase 1 bbl. for each produced barrel of water if it be desired to maintain oil-producing rates.

TABLE 17-2—CONSTANTS FOR PRODUCING UNIT NO. 1

	Injection row i1	Producing row p_1
Bottom-hole pressure, psia.	1,400	400
Oil rate, bbl. per day	....	7,000
Volumetric rate, bbl. per day	7,800	7,800
Average completion, feet per well	50	38
Reservoir-well permeability, md.	200	200
Viscosity, cp.	1.0	3.5
Interference factor	0.64	0.384
Diameter of wells, in.	8	8
Distance between rows, ft.	6,600	6,600
log 2d/r	4.6	4.6

Well requirements for Unit 1 will be estimated in terms of the constants itemized in Table 17-2. Bottom-hole injection pressure is 1,400 psia. The bottom-hole producing pressure is 400 psia. This is also the saturation pressure for the oil. The wells are pumped. Injection wells constitute a one-row system and the interference factor is 0.64. But the p1 wells alternate with, or near to, the p2 wells. Accordingly, the p1 wells are a part of a two-row system for which the interference factor is 0.384.

Let P equal the reservoir pressure. N_{I1} is the required number of injection wells and N_{P1} is the required number of producing wells. Upon substituting values in the equation for well capacity, the total number of wells $N_1 = N_{I1} + N_{P1}$ for unit No. 1 is given by:

$$N_1 = \frac{1{,}826}{1{,}400 - P} + \frac{14{,}016}{P - 400} \quad (1)$$

The optimum reservoir pressure is the pressure P corresponding to which Unit 1 requires the least number of wells N_1. Differentiate N_1 with respect to P, equate the result to zero and obtain:

$$\frac{1{,}826}{(1{,}400 - P)^2} = \frac{14{,}016}{(P - 400)^2} \quad (2)$$

Equation 2 gives 1,260 psia. for the optimum reservoir pressure. Therefore, the number of required injection wells aside from plugging and water encroachment is given by:

$$N_{I1} = \frac{1{,}826}{1{,}400 - 1{,}260} = 13$$

and the number of producing wells:

$$N_{P1} = \frac{14{,}016}{1{,}260 - 400} = 16$$

But the optimum operating reservoir pressure, injection wells and producing wells for unit No. 1 must also satisfy the optima for Units 2 and 3. So the above optima are subject to revision in the light of the requirements of all three units combined as will be shown in the next article.

Cooling-Tower Performance

(Continued from page 134)

51 ft. Ch = 1.63. Substituting the new Ch in the formula we find that a 65½-ft.-long tower is required.

Problem 4.—Assume the conditions of this problem are identical to those of Problem 1, except that water has to be cooled from 85° F. to 70° F. and the wet bulb temperature is 65° F. From Fig. 7, when the wet bulb temperature is 65° F., Cw = 0.86. Substituting this factor in the general formula we find tower length to be 124 ft.

Problem 5.—Once a tower is installed the problem often arises of determining what cold-water temperature one can expect under conditions differing from those for which the tower was designed. For example, let us take the tower calculated for Problem 1. This tower is 35 ft. high, 12 ft. wide, and 107 ft. long. What cold-water temperature, T_2, can be expected when the wet bulb temperature is 60° F., wind velocity 4 m.p.h., cooling range 15° F., and water circulation 2,000 g.p.m.?

The wet bulb temperature correction factor Cw from Fig. 7 is 0.71. The wind velocity correction factor (W) from Figure 9 is 0.875. By substituting these values in the general formula and solving for water concentration, we find:

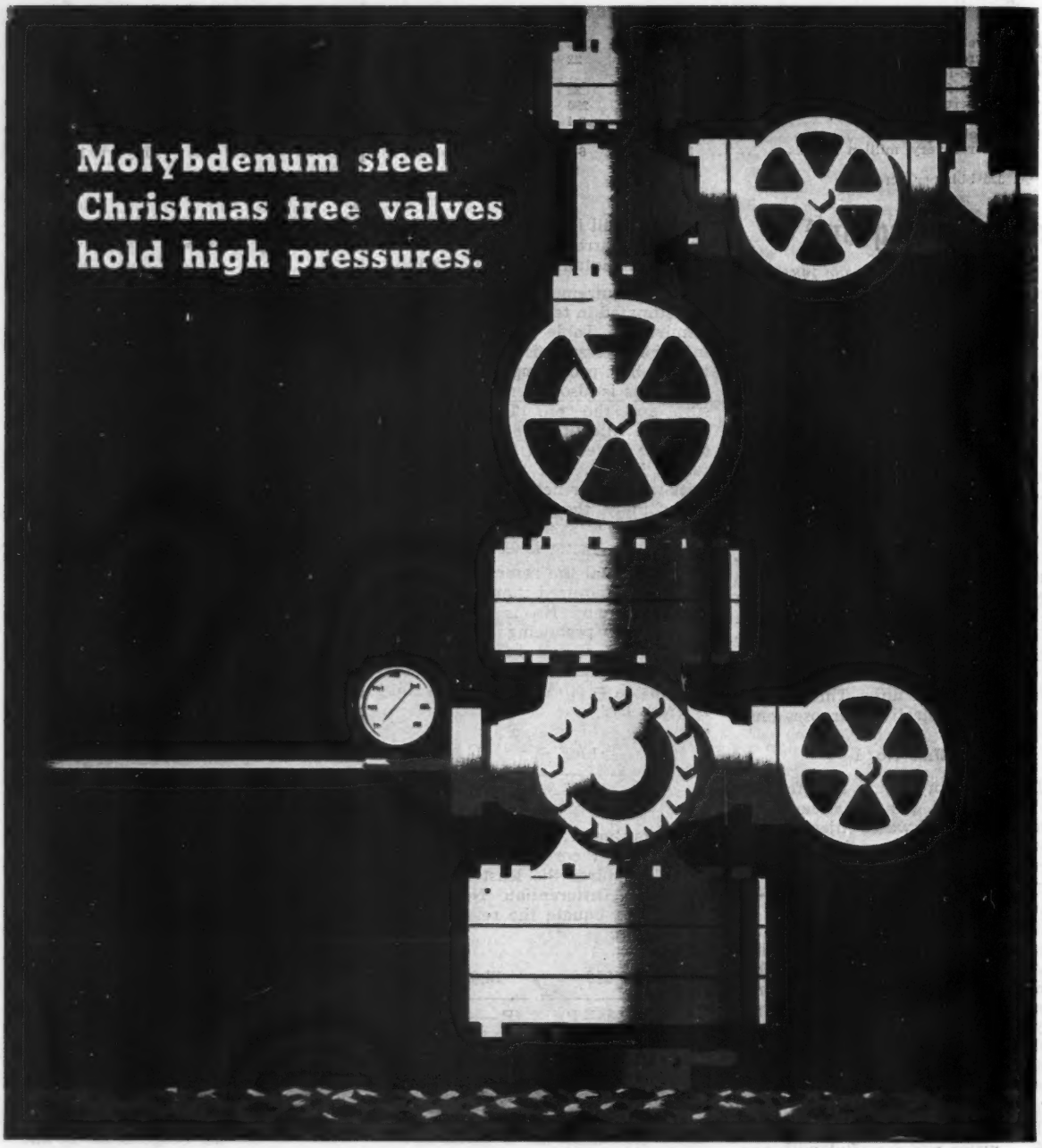
$$C = \frac{2{,}000 \times 0.875}{107 \times 12 \times 0.71 \times 1}$$

$$= 1.92 \text{ gal. per sq. ft.}$$

Turning to Fig. 6, we find that when the cooling range is 15° F. and the water concentration is 1.9, the approach to the wet bulb temperature is 9° F. This means that the cold-water temperature will be 60° F. + 9° F. = 69° F.

Housing Program Planned

A 150-family housing project for the expanding personnel staff of Socony-Vacuum Oil Co., Inc., in its research and development laboratories in Paulsboro, N. J., is being planned by Socony-Vacuum and New York Life Insurance Co. Under the preliminary plan, the insurance company would develop and manage the project.



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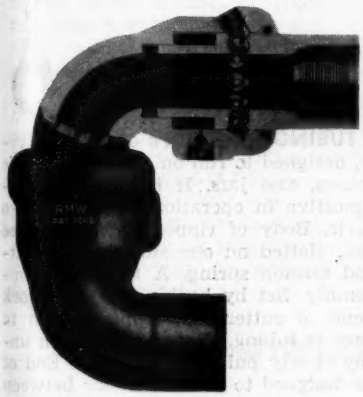
OIL AND GAS EQUIPMENT Digest

IT'S NEW ✓ CHECK IT

by John M. Spears

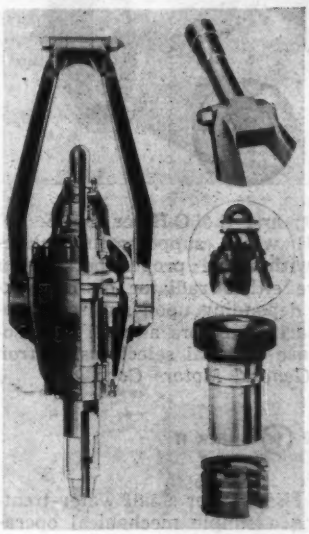
(1) HIGH-PRESSURE SWIVEL JOINT meets the ever-increasing pressures encountered in deep-well drilling, cementing, acidizing, and plastic work. Joint achieves a working pressure of 10,000 psi. with a test of 20,000 psi. and still maintains adequate safety factors. Joint will swivel by hand at 50 per cent of the working pressure and rotates 360°. High-temperature, high-pressure Chevron packing is used throughout. Roller bearings are flat with outer surface slightly oval for clearance in roller races. Packing chamber permits lubricant to lift lips of packing the instant pressure is applied, preventing leakage at any point. A gasket between male and female members serves to resist abrasion caused by the turbulence of fluid, drilling mud, or cement passing through the joint at this point. There are no locking rings or bolts and no adjustments to be made. No special tools are needed for replacement of parts. *Roofe Machine Works.*



IT'S NEW ✓ CHECK IT

(2) WATER-FOG EXTINGUISHER supplies finely atomized water with medium pressures normally provided by plant and city water systems. Unit connects directly to water line. A swing-joint mounting enables fixture to turn in alignment with direction of the hose pull. A 50-ft. length of ¾-in. high-pressure hose is racked in a figure 8 position for fast removal without kinking. Laboratory tests report a 20-ft. fog projection at 50-lb. nozzle pressure with a gallonage discharge of 15.9 per minute. Water fog dilutes vapors, reducing the hazard of an operator being overcome by gas or smoke. *Bowser, Inc.*

IT'S NEW ✓ CHECK IT



(3) NEW OIL-FIELD SWIVELS are designed for medium and deep drilling. Unusual design features include: a two-piece, demountable, steel bail; simplified hose connection permitting packing replacement without disconnecting hose; venturi-type wash pipe and sleeve; cartridge-style wash-pipe packing; maximum vertical spacing at radial roller bearing which maintains positive alignment of sleeve and packing assembly with wash pipe. Packing is so designed that sealing lip of each ring acts free and independently from the others. All pressure is absorbed by solid outer portion of ring rather than compressing entire packing. *Emsco Derrick & Equipment Co.*

IT'S NEW ✓ CHECK IT

(4) NEW TWIN-6 DIESEL consists of two basic six-cylinder two-cycle engines which are geared to a single shaft. Units are offered with either right or left-hand rotation. Continuous brake horsepower at 1,800 r.p.m. is 276 with a maximum rating of 400 at 2,000 r.p.m. A variety of power takeoff arrangements include: the heavy-duty power takeoff which takes pulley and chain-drive side thrust without the need for a special cradle-mounted sheave or sprocket; the stub shaft which is

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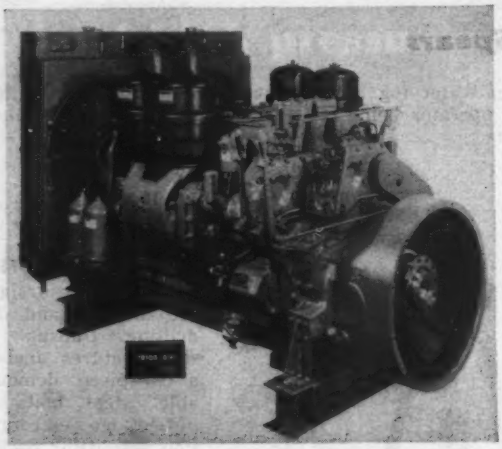
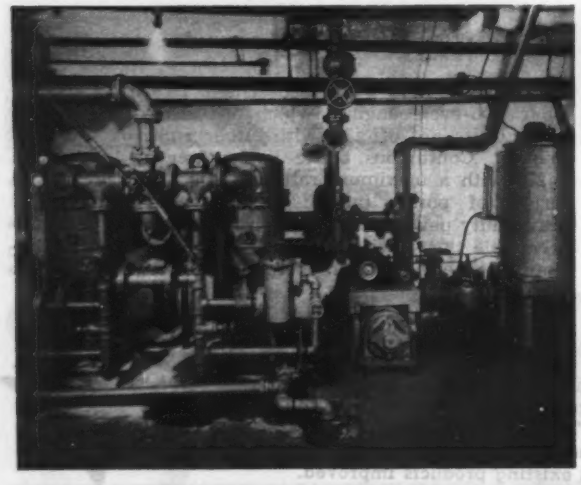
used with any of the various types of couplings encountered with compounds, etc.; the drive flange which is used where the driven machinery is to be coupled directly to the power unit; and the O.H. or S.A.E. "0" size housing (illustrated) which supports any close-coupled power takeoff within the proper horsepower range. Engine units have either radiator or heat-exchanger cooling systems, depending upon nature of application. Dual electric starting motors as well as gasoline starting equipment are optional selections. *Detroit Diesel Engine Division, General Motors Corp.*



IT'S NEW CHECK IT

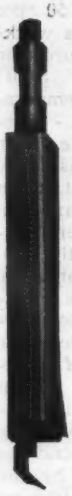
(5) PUR-O-CEL WATER FILTER, for small water-treating plants, makes filtering a simple mechanical operation, not a chemical process, and requires no skilled operators. Filter utilizes thin mats of diatomaceous earth in the filter influent line. This suspension passes through the raw-water compartment and is deposited on the filter septa by the flow, forming a porous cake on each septum. This cake, through which the liquid is forced, has openings hundreds of times finer than the finest mesh. System produces clear, safe water—removes all amoebic dysentary cysts and many bacteria. Unit is much smaller than a sand filter of same capacity. Back washing of filter for cleaning is easily accomplished without dismantling unit and with a comparatively small volume of water. % *Proportioneers, Inc.* %.



IT'S NEW CHECK IT

(6) NEW ELEVATOR LINKS provide drilling efficiency and economy. Links are available with bent or straight upper and lower eyes. Wire line handles are optional. Heat treated to rigid requirements, each link is checked 100 per cent for hardness and dimensional requirements and magnafluxed to assure highest quality. *Web Wilson Oil Tools.*

IT'S NEW CHECK IT



(7) NEW TUBING RIPPER is of the drive-down type, designed to run on a line with rope socket, sinkers, and jars. It is simple in design and positive in operation with only two moving parts. Body of ripper is of one-piece construction, slotted on one side to take cutter bar and tension spring. A trip lock completes assembly. Set by hooking the trip lock over the end of cutter bar, ripper is run to desired place in tubing. Cutter bar is then unsheathed by slowly pulling up on line. End of trip lock is designed to catch in collar between tubing joints, pulling away from cutter bar. Tension spring then forces the cutter bar into position for ripping. *Larkin & Co.*

IT'S NEW CHECK IT

(8) NEW LEAK DETECTOR for vacuum systems renders complicated devices and procedures unnecessary; it eliminates need for shutting down vacuum systems in order to detect a leak; and it enables anyone who can read a dial to locate the leak. A heated wire, housed in a metal chamber, is part of a Wheatstone Bridge circuit.

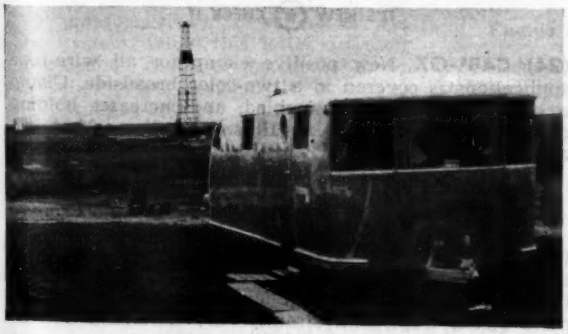
When a vacuum is pulled on the chamber, the filament becomes slightly chilled, upsetting balance of Wheatstone Bridge and causing a needle to rise on scale of meter. Instrument registers a leak as small as the equivalent of 0.006 in. water, which causes a ⅛-in. deflection of needle on scale. Unit is operated by a portable battery, and has a short tube having a rubber suction cup on the end to be applied at point of detection. *Davis Emergency Equipment Co., Inc.*

IT'S NEW CHECK IT

(9) HYFLOW OIL FILTERS, for high flow rates, are used to purify lubricating and fuel oils in diesel engines, gas and gasoline engines, and steam turbines; also to purify industrial oils in compressors, etc. Oil is delivered to inlet of filter and is forced from outside of filter cartridge toward the center and then out through the outlet back to system, either by means of an auxiliary motor-driven pump set or directly from engine or equipment pressure. Filter elements used in units are made of Hiltex-Cellulose to handle additive type oils, or Hilite-fullers earth for handling straightrun mineral oils. Units are available with or without heaters. *Hilliard Corp.*

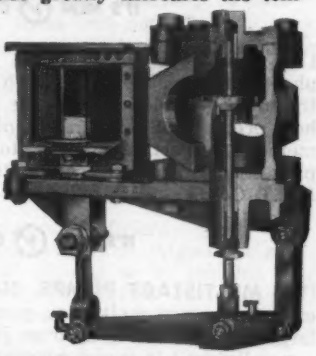
IT'S NEW CHECK IT

(10) NEW SPARTAN TRAILERCOACH of all-aluminum construction provides housing for field personnel engaged in geophysical surveys, drilling, lease work, etc. Light weight (3,500 lb.) and minimum upkeep problems make it ideal for off-highway field use. Unit consists of large observation lounge, bedroom, and gallery. Lounge has two chairs, tilt-back divan, drop-leaf table with storage space, large cabinet, two wardrobes, venetian blinds, and draperies. Bedroom is furnished with full-size bed, vanity, lavatory, wardrobe, and medicine chest. Galley is complete with stove, ice box or refrigerator, two sinks with metal drainboard, and ample storage space. Sleeps four. Wired for 110 volts through breaker. *Spartan Aircraft Co.*



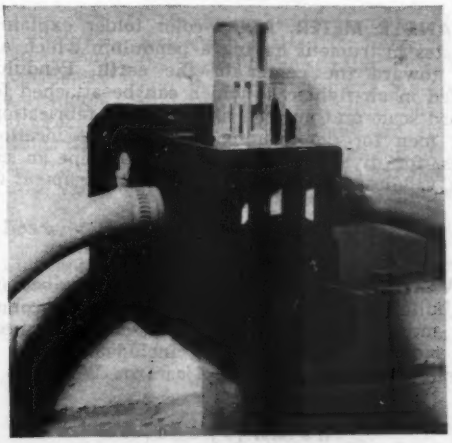
IT'S NEW CHECK IT

(11) DIRECT-ACTING SOLENOID VALVE combines immediate full flow with the ability to operate under differential pressures as high as 150 lb. It can be used for all types of liquid-level control, with hot or cold water, steam, oil, and other processing liquids. Valve is direct-acting—not pilot operated. Solenoid is conservatively rated and lever arrangement provides ample power to insure positive opening of valve. Single-seat construction eliminates silt or other foreign matter from freezing the piston and also greatly increases the temperature range. In normal position the valve is closed; when solenoid is energized the valve opens instantly to full capacity. There is no time lag or delay, and no wire drawing of valve or seat that often results when valves open and close slowly. *Johnson Corp.*



IT'S NEW CHECK IT

(12) SURECLOR WATER STERILIZER, for temporary or permanent out-of-the-way camps, will keep out harmful bacteria, algae, and other impurities in drinking water. Portable purification unit works on jet-spray principle, mixing in proper amount of chlorine solution to water stream. Sterilizer is made of plastics impervious to chlorine and has no moving parts or pumps which require maintenance. Included with regulating unit are three lengths of heavy rubber hose, a strainer and tee connection, clamps, and water-testing set. *Paddock Engineering Co. of Texas.*



IT'S NEW CHECK IT

TRADE LITERATURE

(13) PORTABLE LIGHTING. New 16-page bulletin includes description of derrick "String-A-Lite," in complete sets ready to install, for safety lighting on any height derrick. A typical layout is provided for 122-ft.

derrick. Emphasizes easy installation and 100 per cent salvage value. *Mines Equipment Co.*

IT'S NEW ✓ CHECK IT

(14) PORTO-POWER HYDRAULIC EQUIPMENT. New 24-page book covers hydraulic jack equipment, along with attachments for push, pull, press, clamp, bend, and lift operations. Pipe benders are included, along with gage equipment which adapts hydraulic power to laboratory uses. Of special interest to maintenance personnel. *Blackhawk Manufacturing Co.*

IT'S NEW ✓ CHECK IT

(15) ENGINEERING DATA SHEETS cover various phases of water treatment such as scale, corrosion, after treatment, colloids, etc. Sheets show clearly and simply how organic-colloidal treatment and inorganic chemical methods respectively apply to the various individual phases and problems of water treatment. *American K.A.T. Corp.*

IT'S NEW ✓ CHECK IT

(16) MULTISTAGE PUMPS. New catalog covers vertically split case multistage pumps, which are built for larger capacities ranging from 50 to 200 g.p.m. Pumps are generally used in direct connection with electric motors, but may also be driven with steam turbines, gasoline engines, or by chain or belt-drive arrangen.ents. *Economy Pumps, Inc.*

IT'S NEW ✓ CHECK IT

(17) ANGLE METER. A two-color folder explains and illustrates instrument having a pendulum which always hangs toward the center of the earth. Pendulum is mounted in air-tight case which can be attached to any standard scale and may be used by pipe fabrication and layout men for determining the different locations of fittings, for dividing circumferences of pipe in cutting miters, saddles, bull plugs, etc. *Handy Instrument Co.*

IT'S NEW ✓ CHECK IT

(18) VERTICAL STEAM ENGINES are described in six-page bulletin as sturdy, heavy-duty, and economical prime movers for oil-field use. Description, specifications, and dimensional drawing included. Covers latest equipment in the steam line. *Ajax Iron Works.*

IT'S NEW ✓ CHECK IT

(19) NEW WIRE-LINES MANUAL gives condensed coverage of the entire subject of oil-country wire lines, yet its compact size takes little space on a reference shelf or in a pocket. One-third of manual is devoted to fundamental engineering data on wire ropes and general principles governing their use and selection. Recommendations are given for wire lines used in rotary drilling rigs, cable-tool drilling, production, and refinery operations. Selection tables and diagrams included. *Rochester Ropes, Inc.*

IT'S NEW ✓ CHECK IT

(20) CHEMISTRY OF FATTY ACIDS. New nine-page technical booklet contains information and formulas on fatty acids. Description includes numerous compounds, their sources, and their application. References in literature list describe some 75 fatty acids. *Armour & Co.*

IT'S NEW ✓ CHECK IT

(21) HARBORMASTER POWER. New 26-page brochure describes in detail marine equipment adaptable for offshore drilling operations. Outboard propulsion unit is especially designed for use as propelling and steering equipment on barges, scows, derricks, pile drivers, coastal tugs, and work boats. Specifications and dimensional drawings given for eight different models. Illustrated in four colors. *Murray & Tregurtha, Inc.*

IT'S NEW ✓ CHECK IT

(22) ELECTRIC PLUGS for drilling, exploration, process industries, etc., are thoroughly covered in 76-page, 3-color booklet. Digest gives ideas on quicker and better assembly, easier servicing, maintenance, and greater portability of electrical equipment through use of "quick disconnect" connectors. *Cannon Electric Development Co.*

IT'S NEW ✓ CHECK IT

(23) RUBBER IN THE OIL INDUSTRY. In December 1946 issue of "Us," a company publication, is an interesting story entitled "We Serve the Oil Industry," in which the background and use of various rubber products is portrayed. Special emphasis is given to the function and use of synthetic rubber in petroleum work. Field photographs accompany story. *United States Rubber Co.*

IT'S NEW ✓ CHECK IT

(24) CABL-OX. New positive clamp for all wire-rope applications is covered in a two-color broadside. Clamp is easily and quickly assembled, and increases holding power as the pull increases. Illustrated. *Nunn Manufacturing Co.*

IT'S NEW ✓ CHECK IT

(25) STEAM PLANT EQUIPMENT. Blowoff valves and tandem blowoff valves for boilers, water columns and water-level gages, expansion joints for steam lines, impulse steam traps, and strainers are described and illustrated in 12-page bulletin. How to specify equipment desired is included. *Yarnell-Waring Co.*

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MODERN Rotary DRILLING

Load and Speed Conditions Of the Hoisting Cycle

FOR the purpose of this series the hoisting equipment of a rotary rig was defined in Installment 2 as consisting of derrick, draw works, wire line, crown and traveling blocks, and auxiliary equipment. With the discussion of the derricks completed, this installment starts consideration of the draw works. In case of power-rig draw works, transmission will be considered as an integral portion of the draw works, with engine-compounding arrangements included in later discussion of the power system.

Before proceeding with discussion of changes and improvements which have been made during the last few years in the draw-works part of the hoisting system of a modern rotary rig, it first is necessary to consider, briefly, two factors: (1) Load and speed conditions during the hoisting cycle, and (2) certain characteristics of engines used for powering of the system. While this latter question belongs really to the discussion of the power system it must be brought up here for better understanding of the problems involved in design and selection of the hoisting equipment.

Load Conditions

Two phases of changes in loading and of the resulting power requirement changes during the hoisting operation[1] must be considered.

Range of loads.—The range of loading of the engine is very wide. During pulling pipe out of the hole the engine is loaded heavily about half of the time. During going in the hole the engine is loaded only a small portion of its capacity. For the round trip as a whole the engine is loaded to its full capacity only a very small portion of the time. Nevertheless, sufficient power must be available to meet the full demand. Fig. 13 shows typical load conditions during hoisting and lowering of one stand of pipe.

Engine and Hook Loads

It must be realized that hook-load changes differ from engine-load changes when the pipe is pulled out of the hole. That means that the weight-indicator load does not represent the engine-load requirements. As each stand of the pipe is withdrawn, the load on the hook continues to decrease until it reaches the empty-block loading. With a fixed maximum engine speed, the load on the engine decreases within each gear range. However, when the hoist is shifted to the next higher speed, the engine again becomes loaded to capacity for a certain period of time, assuming that the change has been made at proper point. Fig. 14 illustrates these load conditions.

The nature of engine loading during coming out of hole will be considered again in the following installment from the point of view of its effect on the design of power-rig draw works.

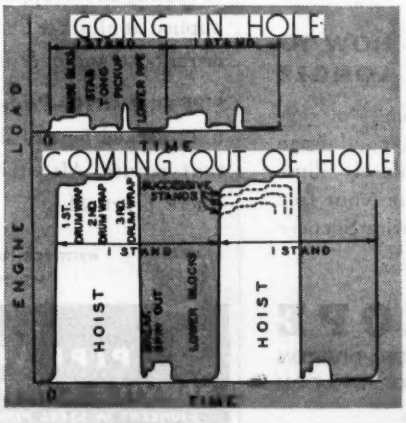
Speed Conditions

Minimum efficient speed of hoisting when the largest weight of drill pipe is to be handled is generally referred to as "off bottom" speed. Rate of 100 ft. per minute is considered as satisfactory and desirable. Available power, which is capable of hoisting a given load from a given depth at this rate of speed, determines equivalent lengths of pipe of different sizes, which may be handled satisfactorily.

Maximum desired empty-block line speed is used for determining the engine-to-hoist ratio. This ratio may be calculated using the above line speed and assuming that normal number of lines are strung, that the engine is running at recommended speed, and that the line is on the second layer on the drum.

Reference

1. W. S. Crake, "Modern Rotary Drilling Machinery and Practices," The Oil and Gas Journal, July 7, and August 4, 1945. Charts shown are from the reference cited.



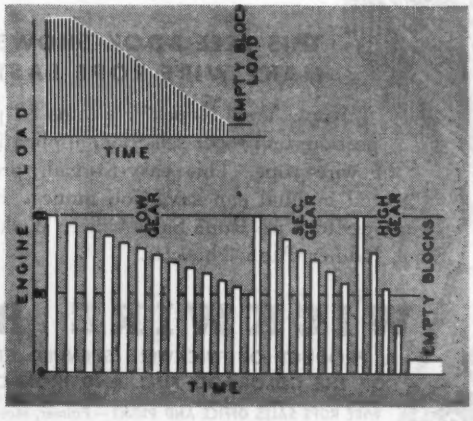
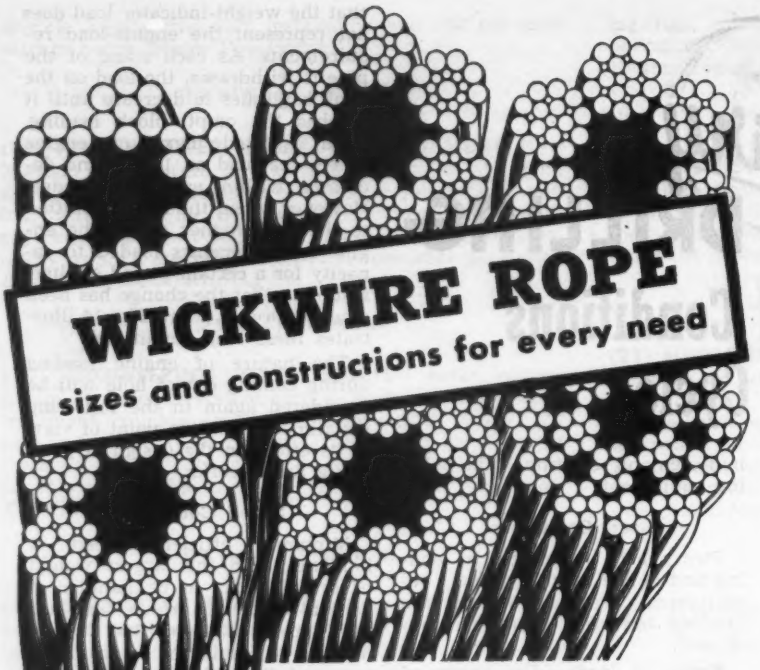


Fig. 13—(Left) Load conditions during pulling and lowering of one stand of pipe. Fig. 14—(Right) Hook and engine loadings during coming out of hole

No. 13 in a series by Joseph Zaba, petroleum engineer, Houston



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The Refiner's Notebook

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL

50-Ft. Steel Stacks

THE Refiner's Notebook No. 135 mentioned that the stack gases are cooled as they flow through a stack. Thus, the average temperature of the flue gas is dependent on the length of the stack and the prevailing weather. These factors have been related (The Oil and Gas Journal, September 30, 1943, pages 56 and 62) by the following approximate equation:

$$\frac{T_2 - T_A}{T_1 - T_A} = \frac{37\sqrt{V} - 0.89\,UH}{37\sqrt{V} + 0.89\,UH}$$

in which:

T_2 = inlet temperature, °F.
T_1 = outlet temperature, °F.
T_A = air temperature, °F.
V = volume of flue gas, cu. ft. per sec. at 60° F.
H = height of stack, ft.
U = over-all heat-transfer rate, B.t.u. per sq. ft.-hr.-°F. temperature difference

The tabulation for 50-ft. stacks shown on this page (and also a similar tabulation to appear in Notebook No. 139) are based on a value of U of 1.3. A value of U of 1.3 applies to a condition of high wind which carries rain or snow. Various weather conditions and a ceramic construction require values of U approximately as follows:

	Value of U
Steel stack, no wind	1.0
Steel stack, dry wind	1.2
Steel stack, wet wind	1.3
Brick chimney, wet wind	0.3

A velocity of 16 ft. per second (at 60° F.) was used in making the tabulation. A lower velocity results in slightly larger drafts (less cooling of the flue gases) and a higher velocity results in less draft because of friction losses and more cooling of gases.

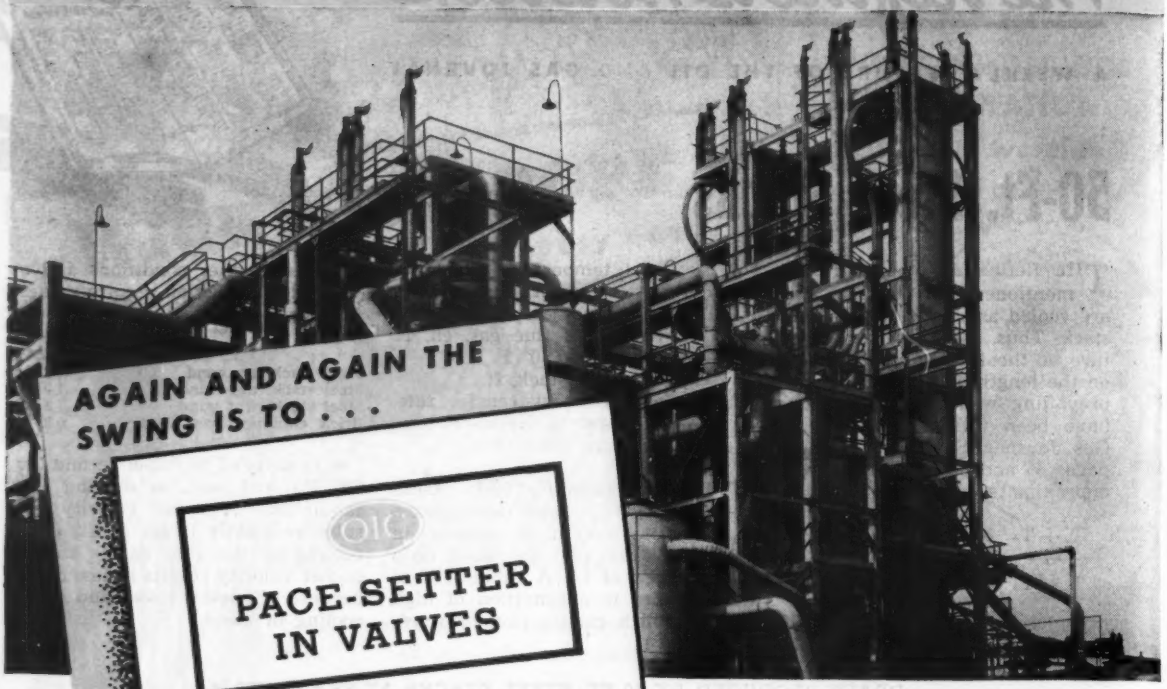
DRAFT PRODUCED BY 50-FT. STEEL STACKS AT SEA LEVEL

(Weather—High Wind with Rain)

Inlet temp. (°F.)	Stack dia.	Air temperature, °F. 0° F.		20° F.		40° F.		60° F.		80° F.		100° F.	
		3	15	3	15	3	15	3	15	3	15	3	15
300		.14	.16	.17	.19	.20	.22	.23	.25	.26	.28	.28	.30
325		.16	.18	.19	.21	.22	.24	.25	.27	.28	.30	.30	.32
350		.17	.19	.20	.22	.23	.25	.26	.28	.29	.31	.31	.33
375		.19	.20	.22	.24	.24	.26	.28	.29	.31	.33	.33	.35
400		.20	.22	.23	.25	.26	.28	.29	.31	.32	.34	.34	36
425		.22	.24	.25	.27	.27	.29	.30	.32	.33	.35	.35	.38
450		.23	.25	.26	.28	.28	.30	.32	.34	.35	.37	.37	.39
475		.24	.26	.27	.29	.30	.31	.33	.35	.36	.38	.38	.40
500		.25	.27	.28	.30	.31	.33	.34	.36	.37	.39	.39	.41
525		.26	.28	.29	.31	.32	.34	.35	.37	.38	.40	.40	.42
550		.26	.28	.30	.32	.33	.35	.35	.37	.39	.40	.41	.42
575		.27	.29	.30	.32	.33	.36	.36	.38	.39	.41	.41	.43
600		.28	.30	.31	.33	.34	.36	.37	.39	.40	.42	.42	.44
625		.29	.31	.32	.34	.35	.37	.38	.40	.40	.42	.42	.44
650		.30	.32	.33	.35	.36	.38	.39	.41	.41	.43	.43	.45
675		.31	.33	.34	.36	.37	.39	.40	.42	.41	.43	.44	.45
700		.32	.34	.35	.37	.38	.40	.40	.42	.42	.44	.44	.46
725		.32	.34	.35	.37	.38	.40	.41	.42	.43	.44	.45	...
750		.33	.35	.36	.38	.39	.41	.41	.43	.44	.45	...	...
775		.33	.35	.37	.38	.40	.41	.42	.44	.45	.46	...	...
800		.34	.36	.37	.39	.40	.42	.43	.45	.45	...	...	...
825		.34	.36	.38	.40	.41	.43	.44	.45	...	...	...	...
850		.35	.37	.38	.41	.42	.44	.45	...	...	...	...	...
875		.35	.38	.39	.42	.42	.45	...	...	...	...	...	...
900		.36	.38	.40	.42	.43	.45	...	...	...	...	...	...

No. 137 in a series by W. L. Nelson, professor of petroleum refinery engineering, University of Tulsa

ANOTHER BIG NEW REFINERY INSTALLS OIC VALVES



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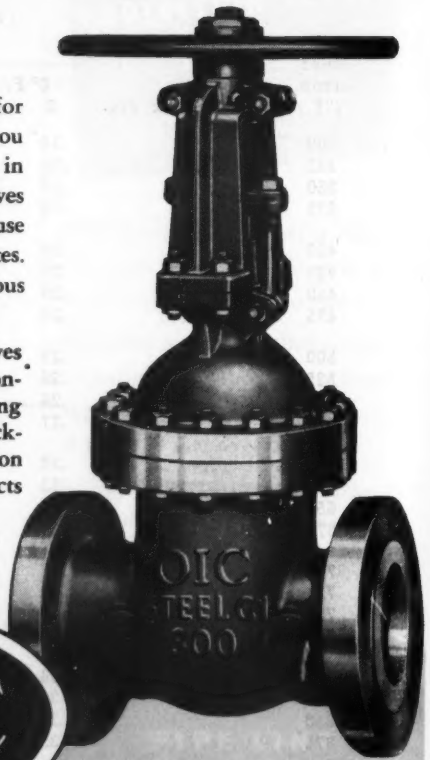

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OIC VALVES

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ENGINEERING fundamentals

No. 279

Mud Changes Formation Permeability and Productivity

IN drilling wells it is a requirement that drilling fluids have a higher hydrostatic pressure than the formations which are to be drilled. Should the weight of the mud exceed that of the bottom-hole pressure the well will blow out. Since the mud column is of heavier weight than the formation pressure, a normal permeable sand will allow drilling mud to filter into sand bodies. This causes a sealing sheath over the sand face.

There have been cases of producing wells starting to pump mud as a result of a drilling well nearby. Fractures and fissures alone will not account for this mud invasion of the producing well. It is therefore reasonable to assume that the mud and water either filter or invade a sand body to an extent that makes it impossible to determine just how far the penetration has reached, especially in wells of high permeability and low bottom-hole pressure. These muds, in penetrating the formation, have a tendency to bridge or cause a tighter cementation between the sand grains during drilling and workover operations. This has been observed in many wells equipped for a drill-stem test. A well with a high bottom-hole pressure will push a part of these muds out of the formation and channel through the mud sheath when the test tool is opened. On wells of low bottom-hole pressure, the muds, due to packing, hold back the pressure from the test tool in many instances. Many wells have been abandoned and many barrels of oil left in the formation due to such occurrences as these.

A pertinent question here would be "How do you know that the muds have penetrated the sand body and decreased the permeability or shut off production?"

In working on wells it has been discovered in many instances that mud sheaths have been removed years after the well had become a producer. Underreaming sand bodies in old producing sand wells reveals the sands to be hard and crystallized. These sands were soft and open when drilled originally.

One well in particular had stopped producing and the liner was removed. The lower portion of the liner held mud which had become hard due to formation heat and packing. The mud was not removed at completion because of improper washing, and yet this operator had set his tubing some distance above the screen or perforations to wash the well. The well was not producing from the entire sand body so the muds were not removed. Another factor noticed after the removal of the liner was in reaming the sands for a greater drainage area. In the reaming operation, which was done with oil, chunks of mud plaster were removed. Presumably the muds were never completely removed from the well, and a great deal of the effective drainage area was not being allowed to produce.

Drilling crews have often noticed the disappearance of muds during coring operations in a sand body. The loss of mud is slow and is hardly perceptible at first. Commercial muds have to be added. During the drilling of the hole the rig crews have had to continually jet extra muds into the reserve pits. One could only assume that these muds are filtering into the sand body from which the cores are being taken. A greater evidence of the disappearance of mud is during workover operations where commercial muds are constantly being added to the mud pits even though no new hole is being drilled. These drilling muds and the fresh water with them, filtering back into the sand body, tend to change the entire characteristics of the sand body as well as the future production of the formation.

Common practice in killing a flowing well is first to partially kill the well with water, or at least run some 20 to 30 bbl. of water ahead of the muds. This is done to reduce contamination of the fluids in the hole with that of the muds. This fresh water enters the formation, and causes a certain amount of blocking by the swelling of some of the materials in the formation. Tests have proved that the permeability is reduced sometimes as much as 60 to 100 per cent. Cementation in the sand body can be dissolved by the use of acids and a large percentage of the permeability restored, if not increased.

One other case is that of a well in the Luling sand, which is in the Tertiary Wilcox sand area. The well was producing 50 per cent salt water. It was squeezed seven and shot nine different times. A total of 745 sacks of cement were squeezed in the formation. After each of the first six operations, the well tested, after being shot, from 50 to 100 per cent salt water. This is not unusual, but after the sixth operation the interesting item is that after the well had been drilled in, dry tested, shot, dry tested, shot again, and dry tested again, the operators realized the formation was either cemented to such an extent that it would not produce or was stopped up.

A treatment of acid was suggested and used in the following manner. The well was equipped for production. The bottom of the tubing had a 12-in. bull-nosed perforated seating nipple which was placed within 12 in. of bottom. The well was washed around with clear water. Acid was put in the tubing, displacing the water on bottom, and the casing valve was closed. The acid was left on the formation 5 minutes and the casing valve opened. Some 10 gal. of water was bled off. This procedure was repeated five times until there was approximately 1½ bbl. of acid in the tubing. This was pumped in the sand formation at a breakdown pressure of 1,700 lb., whereas the pressure built up to 3,800 lb. by using muds. The well was washed with oil and blown around by the use of gas. This well produced some 89 bbl. of oil with 40 bbl. of water. The well was squeezed the seventh time and the same procedure followed as far as the drilling, shooting, testing, and acidizing, with the same result.

Series Prepared by Edward N. Jones, consulting engineer, Pettus, Tex.

REFINING

More Volatile Gasoline Possible, Tests Indicate

IN a series of road tests, the Natural Gasoline Association of America reports it is finding that more volatile fuels give trouble-free operation at atmospheric temperatures ranging up to 70° F. Though undertaken as a study of winter motor fuels, incomplete results in spring-like temperatures indicate most car models can safely handle fuels having a vapor pressure at least 2 lb. R.v.p. higher than present regulations permit.

The test series is being conducted out of Bartlesville, Okla., by the N.G.A.A. technical committee under the direct supervision of H. R. Legatski, Phillips Petroleum Co., chairman of the committee.

The A.P.I. vapor-lock road test procedure is being followed, and nine of the 14 makes of cars have already been tested. The base fuels being used have a Reid vapor pressure of 13 lb. One of these is highly volatile with 70.2 per cent evaporated at 212° F. and the other relatively nonvolatile having 41.5 per cent evaporated at 212° F. These fuels are tested individually in the cars and butane is then added to obtain vapor-locking pressures.

In all but one of the cars tested thus far, the Reid vapor pressure for safety from vapor lock at atmospheric temperatures of 60° F. has been found to be 17.75 and 18.75 for the respective high and low volatility fuels. The tentative conclusion being drawn from this information is that the permissible vapor pressure for winter grade motor fuels could safely be raised from 13 to 15 lb., according to an N.G.A.A. report.

Commenting on the Nowata tests, N.G.A.A. President J. H. Dunn, Shamrock Oil & Gas Corp., Amarillo, stated the results to date are highly significant. "If the permissible vapor pressure of winter fuels can be raised by 2 lb. it could easily mean that the northern motor fuel market would absorb more than 1,000,000 bbl. of additional n-butane. It is also reasonable to conclude that spring and fall motor fuels of the same area could stand a 1-lb. increase thus absorbing even more light ends from both the refining and natural-gasoline industries."

The test will be completed about the first of April when the committee will begin correlation of all data. A complete report of the results is to be presented at the twenty-sixth annual N.G.A.A. convention, in Dallas April 23-25.

Leonard's New Cracking Unit Goes on Stream

The new 3,000-bbl. daily catalytic-cracking unit of Leonard Refineries, Inc., at Alma, Mich., for which ground was broken last September, went on stream March 18.

The unit is a Thermofor catalytic-cracking plant licensed and engineered by Houdry Process Corp. and built by its subsidiary, Catalytic Construction Corp. Houdry officials said the unit is the first postwar catalytic cracker to be built which is designed to meet the competitive requirements of the small refiner.

The unit incorporates design simplifications, although it is very similar in its principal features to the larger T.C.C. units, 34 of which are in operation in refineries throughout the country. Reid Brazell, Leonard Refineries, Inc., president, said the catalytic equipment would provide "means whereby we can meet the challenge of competition with a product high in octane rating."

Crude-oil charging capacity of Leonard's Alma refinery is 8,000 bbl. daily.

Richmond, El Segundo Get New Distillation Units

Work is under way on two new crude distillation units at Standard Oil Co. of California's major West Coast refineries. The units, each capable of handling 30,000 bbl. of crude per day, are being installed at the company's El Segundo and Richmond plants.

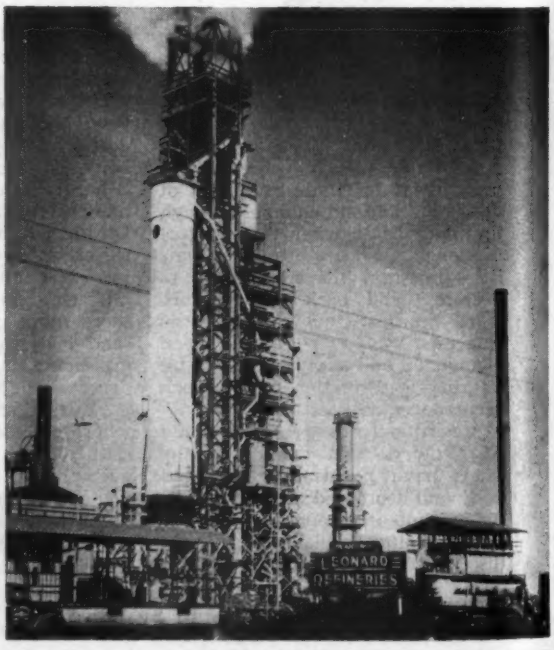
Although designed as replacements for existing facilities, the new crude units will include considerable flexibility for handling a great variety of charging stock and will therefore increase the utilization of the crude.

The units will be of the two-stage atmospheric and vacuum type. The atmospheric column will stand 146 ft. in height and 14 ft. in diameter. The vacuum tower will be 80 ft. high and 15½ ft. in diameter.

The El Segundo installation, begun in September, will be completed early this fall. Work on the Richmond project started in January and completion is expected by the end of the year. Present crude-oil and cracking capacities of the refineries in barrels daily are: El Segundo, 100,000 and 71,450; Richmond, 100,000 and 68,500.

New Husky Plant to Be Operating This Summer

A 2,500-bbl. asphalt refinery at Lloydminster, Canada, being built by Husky Refining Co., is expected to



Over-all height is substantially reduced, and the structure considerably simplified in the new T.C.C. unit at Leonard Refineries, Inc., Alma, Mich., plant. An important simplification is an integral elevator design requiring only one elevator for both spent and regenerated catalyst. Utilization of certain existing thermal equipment in converting the refinery from thermal to catalytic cracking provides substantial savings in investment both for construction and operation. The 3,000-bbl. daily capacity cracking unit was placed in operation last week

be completed and in operation this summer, according to K. E. Dyer, Husky superintendent of refining.

The new plant will handle a 15°-gravity crude from the various asphaltic fields located in the immediate vicinity of Lloydminster. Bad weather during February and early March retarded construction work.

At the company's 5,000-bbl. refinery at Cody, Wyo., a complete vacuum unit is being added to operate as an auxiliary unit to the present refining system, supplying flux for blowing and base material for all types of asphaltic products.

Crude supply for the Cody plant is primarily Oregon Basin crude, but several other crudes are run throughout the year, including Shoshone, Pitchfork, Half Moon, Elk Basin, Waugh Dome, and Buffalo Basin.

Frontier Makes Offer for U. S. Units at Cheyenne

Frontier Refining Co. has bid $1,994,300 for the Government-owned aviation-gasoline facilities adjacent to Frontier's 7,500-bbl. daily crude-capacity refinery at Cheyenne, Wyo.

Frontier, the wartime operator, made the only offer for the plant. Since the end of the war, Frontier has been using some of the facilities on lease. The bid stipulates that $700,000 be deducted from improvements for the first 5 years. War Assets Administration has not announced acceptance of the offer. The facilities include Fluid catalytic cracking, 2,700 bbl. daily; gas concentration; HF alkylation production, 1,100 bbl. daily; and C_4 isomerization, 450 bbl. daily production.

Continental to Submit Ponca City Plant Bid

Continental Oil Co. will submit a bid to War Assets Administration on the Thermofor catalytic-cracking plant constructed by the Defense Plant Corp. adjacent to Continental's refinery at Ponca City, Okla., according to the company's annual statement released early this week.

If the bid is accepted, the report declared, immediate revision of the unit will be undertaken to adapt its facilities to their most efficient use in connection with the Continental plant.

WAA Sells Coffeyville Plant to Cooperative

KANSAS CITY.—Cooperative Refinery Association has bought from War Assets Administration for $1,200,000 the refinery it operated for the Government during the war at Coffeyville, Kans.

Terms of the sale provided for a cash payment of $100,000 with the remainder to be paid September 1, or when the catalytic-cracking plant is placed in operation.

Cost to the Government of the plant, which had a daily output of 1,665 bbl. of high-octane gasoline during the war, was $4,659,804. The refinery has a daily Fluid catalytic cracking capacity of 3,800 bbl.; HF alkylation, 1,000 bbl.; and C_4 isomerization, 400 bbl. WAA on two previous occasions had offered the plant for sale. Original bid of the cooperative of the same amount was rejected, and the plant advertised for offsite use. Highest of these bids was $400,000, submitted by a bidder planning to scrap most equipment, and the bids were rejected again.

Railroad Abandonment Slated to Close Plant

The Bolivar, N. Y., refinery of Allegheny Refiners, Inc., subsidiary of Quaker State Oil Refining Corp., was scheduled to close March 20 as a result of the proposed abandonment of the Shawmut railroad March 31.

Quaker State officials said the railroad provided the only rail service to the plant and its abandonment would leave the refinery without adequate transportation. The plant was bought by Quaker State Corp. in 1945.

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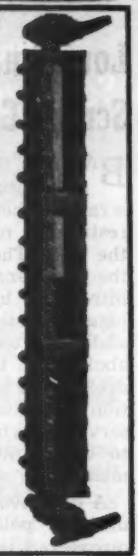
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NATURAL GAS

Louisiana Legislature Scraps Gas Policy

BATON ROUGE.—The Louisiana Legislature late last week scrapped the state's 5-year-old policy restricting natural-gas exports from the state. The issue was settled when the state senate approved a resolution introduced by Senators Reimer Calhoun, Mansfield; A. K. Goff, Houston; and Drayton Boucher, Springhill; abolishing the legislature's policy declaration of 1942. The senate's action also closed the office of gas conservation which was set up in 1944 to carry into action the legislative mandate.

A controversy over the state's natural-gas policy arose when it was discovered that H. L. Hunt interests were producing gas from the Lucky and other fields for movement out of the state via Tennessee Gas & Transmission Co. pipe lines. Hunt's production of 55,000,000 cu. ft. of gas a day from Lucky field in Bienville Parish continued when a District Court in Shreveport recalled the restraining order issued against the Hunt interests. Joseph L. McHugh, conservation commissioner, said he probably would issue an allowable to Hunt in the near future.

Mid-Continent May File New Gas-Line Application

Mid-Continent Gas Transmission Co., which has requested permission to withdraw application to construct a natural-gas pipe line from Liberal, Kans., to Kansas City, Mo., and St. Paul, Minn., has indicated it later will file a new application for authority to build a gas pipe line "more suitable to the public interest."

The company indicated its request to withdraw its current application was necessitated by a lack of commitments of adequate gas reserves, previously indicated as available.

FPC to Hear Memphis Natural Proposal April 1

WASHINGTON.—The Federal Power Commission has set for April 1 a hearing on the proposed acquisition of the gas properties of Kentucky Natural Gas Corp. by Memphis Natural Gas Co. at a price of $4,957,489. The commission has denied requests of the National Coal Association and the United Mine Workers to intervene in the proceedings.

Kentucky's pipe-line system lies principally in Kentucky, Indiana, and Illinois. Memphis' system extends from Lisbon and Monroe fields in Louisiana across a portion of Arkansas and Mississippi to Memphis, Tenn., and other points in western Tennessee.

Natural Gasoline

Four Gasoline Plants To Cost $19,000,000

EXPENDITURE of a total of approximately $19,000,000 is involved in the construction of four natural-gasoline plants which were reported last week. Two of the plants are in Texas, one in Colorado, and one in Louisiana. The projects all are in line with the increasingly important trend toward greater utilization of gaseous hydrocarbons.

The four projects are:

Shell Oil Co., Inc., in TXL field, Ector County, Texas.

Stanolind Oil & Gas Co. and The California Co. in Rangely field, Rio Blanco County, Colorado.

Magnolia Petroleum Co., Sunray Oil Corp., Sun Oil Co., Shell, and Sinclair Prairie Oil Co., in Seeligson field, Kleberg County, Texas.

Sun Oil Co. and C. H. Murphy, Jr., in Delhi field, Louisiana.

Costing approximately $3,000,000, Shell's TXL plant will process 30,000,000 to 40,000,000 cu. ft. of gas daily and will extract propane, butane, and natural gasoline. Residue gas has been contracted for by El Paso Natural Gas Co. which is now building a gas pipe line to California. Construction, now under way, is expected to be completed by the end of this year. Eight 800-hp. gas-engine compressors will be used, and storage facilities will be provided at the plant to handle 27,000 bbl. of products. Gas will be drawn to the plant from TXL and Wheeler field leases through three main gathering lines.

The Rangely field plant is expected to recover from 10,000 to 20,000 gal. of products daily. Contract for construction has been let to Hudson Engineering Co. of Houston, and work is scheduled to start as soon as labor and materials can be assembled. Stanolind and The California Co. has offered all operators in the field a share in the plant and it is expected most of the others will participate. The plant will cost approximately $4,000,000. Another development in Rangely operations reported last week was the scheduling of a meeting for early April in Denver at which a unit agreement is expected to be drawn up.

The Seeligson field operators revealed materials for the plant in that field have been ordered and that some is at the plant site. Earlier this month, the Texas Railroad Commission ordered production in the field halted effective April 1 until flare gas is utilized.

E. O. Thompson, commission chairman, said the order was an unprecedented move to halt gas waste. "All we want is for the useless wastage to stop," Thompson said. "This is a conservation measure only." Thompson said the commission held a hearing in 1945 at which operators were asked to show cause why the field should not be shut down if gas waste continued. "We held another hearing in February 1946 more than a year ago, at which a spokesman for the operators said plans for utilizing the gas were under way. Those plans have not materialized."

Representatives of companies involved in the Seeligson plant said completion of the project is expected by the end of the year with the cycling unit to be operating early next year. These estimates, they said, depend on availability of labor and materials. As planned, the plant will cost between $9,000,000 and $10,000,000; will process between 150,000,000 and 200,000,000 cu. ft. of gas daily, and will yield an estimated 7,000 to 8,000 bbl. daily of products.

Construction already has commenced on the Sun-Murphy plant in Delhi field, Louisiana's largest producing area. In Baton Rouge, Joseph L. McHugh, state conservation commissioner, said the extraction plant would process some 14,500,000 cu. ft. of gas daily. The plant will be located about 2 miles west of Delhi and will cost approximately $2,500,000.

Second C.N.G.A. Chapter Organized at Ventura

The organization of a second chapter of the California Natural Gasoline Association has been announced by M. W. Kibre, C.N.G.A. president.

The new group, known as the Coastal chapter, will meet the third Wednesday of each month at Ventura. C. L. Case, Continental Oil Co., is chairman, and G. C. Elmore, Tide Water Associated Oil Co., secretary.

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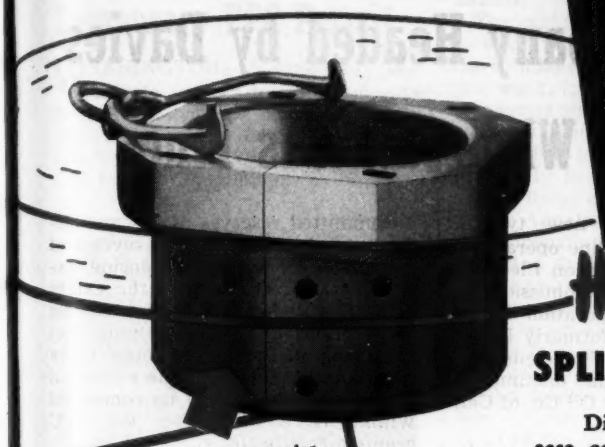

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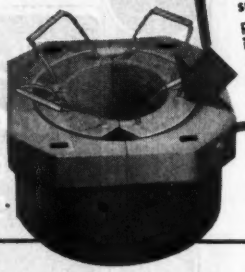
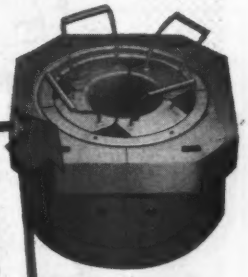
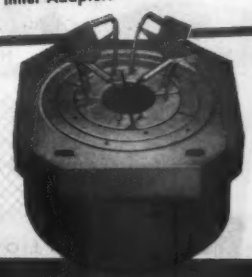
2 For large diameter casing, the Slips seat directly in the bore of the Split Bushing. The extra long internal taper of the Split Bushing permits using long slips having a full-length support and with maximum gripping area. This eliminates crimping or damaging the thin-walled casing through concentration of slip pressure over a small area.

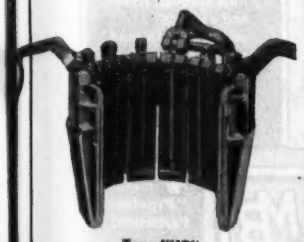




3 For medium sizes of casing, drop in a split and hinged Slip Adapter which is tapered on both sides and sets flush with the top of the Casing Bushing. Slips to fit the casing then seat directly into the split and hinged Adapter.

4 Even the smallest sizes of casing can be run with equal convenience by simply dropping in another concentric split and hinged Adapter, and slips to fit the casing then seat in the tapered bore of the inner Adapter.





Type "UC" Casing Slips

Two Types of Slips

Although the above illustrations show the Casing Bushing being used with conventional solid type of slips with flexible handles, the newly-developed Baash-Ross "UC" Casing Slips can also be used. "UC" Casing Slips provide the added safety of maximum gripping efficiency because they consist of many narrow slip segments flexibly linked together that w-r-a-p around the casing for a full-circumferential grip. Also, "UC" Casing Slips have easily renewable liners for long life and economy. (For more details on "UC" Casing Slips see page 276 of the new Composite Catalog).

Handles Wide Range of Casing Sizes

Modern rotary tables are able to support even the longest and heaviest casing strings with ample safety, and the Split Rotary Table Casing Bushing is ruggedly built to withstand the same service. Yet it is light in weight and readily portable in small tool cars.

The maximum casing size handled by the Casing Bushing is determined by the diameter of the opening through the rotary table. The accompanying chart shows the largest casing size that will pass through the Casing Bushings made for various size rotaries.

Rotary Bore	Maximum Casing Size
27½" Dia.	21½" API
24½" Dia.	18⅝" API
20½" Dia.	16" API
17½" Dia.	13⅜" API

IT'S OK IF OKLAHOMA CONTRACTING CO. INC. Does it!

T. R. JONES

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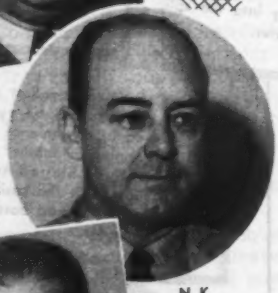


N. K. McFARLAND

R. J. O'CONNELL

DALLAS, TEXAS

PIPE LINES

New Company Headed by Davies Plans Wholesale Gas Line

WASHINGTON.—A new type of natural-gas pipe-line operation is proposed in an application filed with the Federal Power Commission last week by a new corporation headed by Ralph K. Davies, formerly Deputy Administrator of the Petroleum Administration for War and onetime vice president of Standard Oil Co. of California.

Incorporated in Delaware as the Trunkline Gas Supply Co., the new company seeks a certificate to construct 855 miles of 30-in. high-pressure gas pipe line from the Texas Gulf Coast region in Wharton County, Texas, northward through Arkansas and Missouri to a point near Keokuk, Iowa. Estimated cost is $74,266,507, proposed to be raised by public financing. Ultimate capacity would be 425,000,000 cu. ft. of gas daily.

Chief supply would be flare gas now wasted, and the principal business of the company would be to sell gas at wholesale rates to other interstate pipe lines crossing its route. Relatively small sales might be made to local distributing companies or industrial consumers adjacent to its line, but Davies stated that this will be a minor part of the company's business and that its primary objective is to sell to other trunk lines.

The route of the proposed line crosses or approaches lines of Natural Gas Pipe Line Co. of America, Northern Natural Gas Co., Michigan-Wisconsin Pipe Line Co., Panhandle Eastern Pipe Line Co., Cities Service Gas Co., Arkansas-Louisiana Gas Co., and Mississippi River Fuel Corp. All will be offered gas to the limit of Trunkline's capacity, and the proposed line may be enlarged in the future if demands warrant. The proposed rate for firm gas deliveries is a commodity charge of 12 cents per 1,000 cu. ft. plus a demand charge of 3.6 cents per 1,000 cu. ft. of daily demand.

Davies pointed out that most of the transmission companies who are potential customers now draw gas from Panhandle or Hugoton fields where the problem of well deliverability is becoming serious and large additional uncommitted reserves of gas are difficult to obtain. Also that several of these companies are considering expanding their facilities to the extent of 2,500 miles of line pipe involving 500,000 tons of steel, implying that the Trunkline proposal would make such plans unnecessary. He estimated that construction could be completed within 12 months after the FPC grants a certificate.

Trunkline proposes to take gas from Texas Railroad Commission Districts 2, 3, and 4, which Davies says have proved reserves of more than 43 trillion cubic feet, only a small portion of which is now committed to pipe line or industrial use.

IF THE JOB IS
Tough
AND CALLS FOR SPEED..
Yes, 25 miles of pipe line in Mississippi was tough . . . over hills, through rivers and swamps . . . and always in mud and rain. But Morrison Bros. was delivering the goods. Whether the job is "easy or tough going" a contract with MB means "Pipeline Perfection"
MB
MORRISON BROS
CONSTRUCTION CO INC
P O BOX 4106 ODESSA, TEXAS PHONE 1640

Trunkline has not finally contracted for any specific gas reserves but will do so and supply full data at the time of the FPC hearing, the application states.

Texas Eastern Granted Temporary FPC Permit

WASHINGTON.—A temporary certificate to keep the Big Inch pipe lines in gas service on their present basis has been issued to Texas Eastern Transmission Corp. by the Federal Power Commission.

The certificate is effective May 1, the effective date of the interim lease on the lines which the company has obtained from War Assets Administration, and will expire on termination of that lease, which presumably will be the date on which WAA delivers final title under its letter of intent to sell the properties to Texas Eastern.

The certificate is without prejudice to whatever action FPC may take on the company's application, being filed this week, for a permanent certificate to operate the entire system for natural gas when its purchase is completed. The temporary certificate applies only to the western two-thirds of the lines, currently supplying gas to the Appalachian area.

Commencing May 1 Texas Eastern is obligated to deliver through the two lines approximately 130,000,000 cu. ft. per day, and by November 1 this is to be increased to 250,000,000 cu. ft. by the installation of three compressors with a maximum of 18,000 hp. at the location of pumping stations Nos. 5, 9, and 14 of the Big Inch line at a cost not to exceed $3,500,000.

Texas Eastern is to continue the transportation and sale of natural gas through the lines in substantially the same manner and at the same price during the period of its interim lease as is provided by Tennessee Gas & Transmission Co. under its temporary certificate which expires April 30. Within 30 days Texas Eastern must file a general tariff and rate schedule with a maximum sales price of 23 cents per M.c.f. at 15.025 psi. It must deliver gas for ultimate distribution in the Appalachian area and the area served by Panhandle Eastern Pipe Line Co. on a fair and equitable basis, and FPC reserves the right to direct disposition of its gas at any time as may be required in the public interest. The commission said continued operation of Big Inch will enable the purchasing companies to place gas in storage during the summer and will "further partially alleviate the probable severe shortage of natural gas during the winter of 1947-1948."

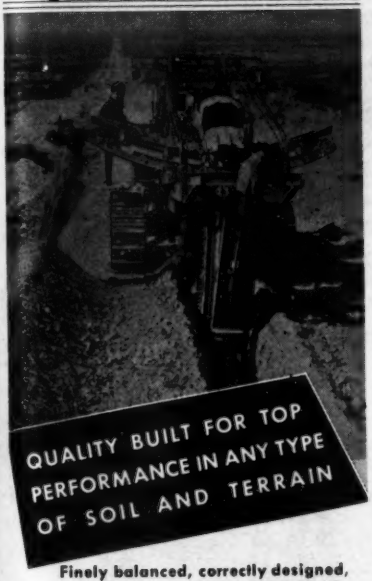
December Pipe Line Fuel Deliveries Drop

Deliveries of motor fuel from pipe lines during December showed a 19 per cent increase over December 1945 but a drop from the amount transported in the month of November.

Figures released by the Bureau of Mines show that pipe lines delivered 17,749,000 bbl. in December, compared to 14,879,000 bbl. in December 1945 and 19,176,000 bbl. in November.

During all of 1946, pipe-line deliveries of motor fuel totaled 218,174,000 bbl., against 281,551,000 bbl. in 1945.

CLEVELANDS



Finely balanced, correctly designed, powerful, rugged, fast and highly resistant to wear and abuse "CLEVELANDS" represent the utmost in trenching economy and efficiency.

THE CLEVELAND TRENCHER CO.
20100 ST. CLAIR AVE. CLEVELAND 17, OHIO

C. S. FOREMAN COMPANY
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PIPE LINES
1221 Baltimore
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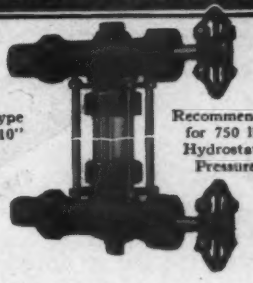
PENBERTHY
DROP FORGED STEEL
LIQUID LEVEL GAGES



Steel construction throughout with stainless steel interior trim. Automatic shut-off is positive and instantaneous: stainless steel balls shut off the flow of liquid when glass breaks. Heavy duty stuffing boxes, union connections, offset construction facilitate cleaning and simplify glass replacement. Conform with A.P.I.—A.S.M.E. requirements.
This is one of the complete line of Penberthy gages that meet every liquid level gage requirement.

PENBERTHY INJECTOR CO.
DETROIT, MICH. Canadian Plant WINDSOR, ONTARIO

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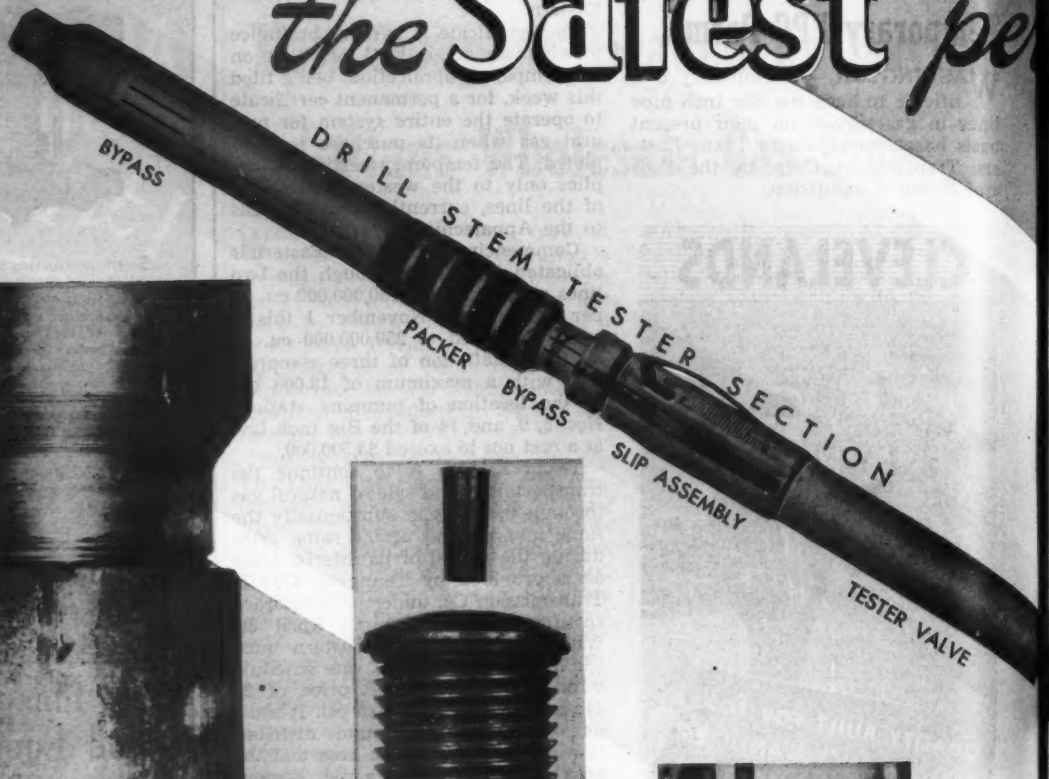
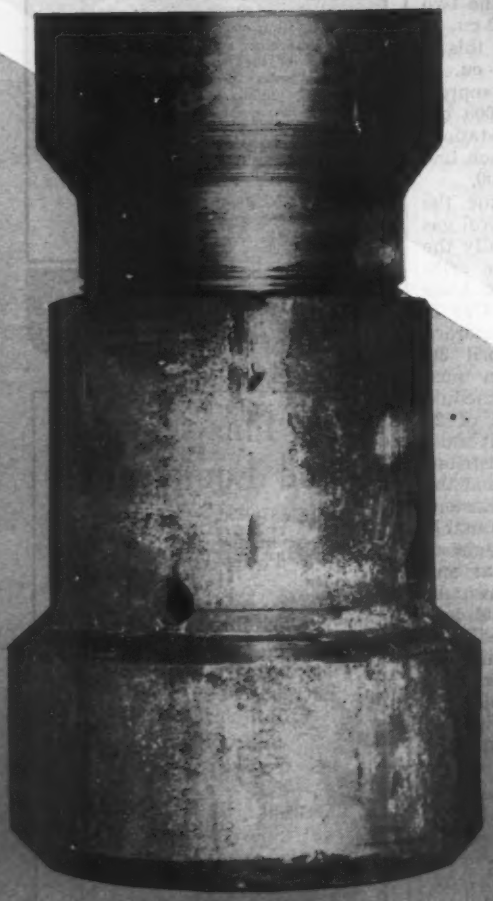
Everything for the Construction and Maintenance of pipe lines

The Clarence L. Boyd Co., Inc.
Phone 8191 LD 725
Tulsa, Oklahoma

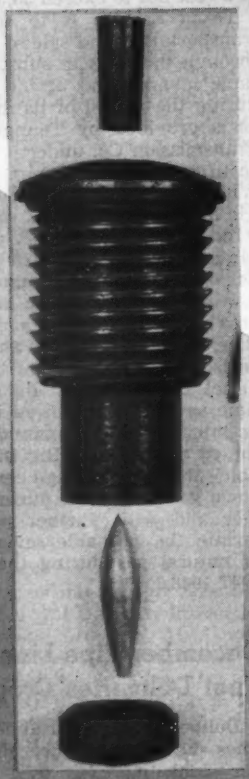
HUNT-CLARK WELL P

the Safest pe





LEAD IMPRESSION BLOCK: Acts as junk pusher . . . provides positive "tell-tale" device that proves complete penetration and absence of large burrs.



GUN BARREL ASSEMBLY: Longer gun barrel gives higher muzzle velocity. "Boat-tail" shaped bullet has less drag and greater striking force . . . greater penetration . . . makes a cleaner hole.

STARTING IN HOLE for shooting and testing.

LOAD
is loc
ered
ble .
above
Neop
ring
seal.

Hunt-Clark Co.

GUN PERFORATING • WELL TESTING •

HOUSTON—CORPUS CHRISTI

HOUSTON
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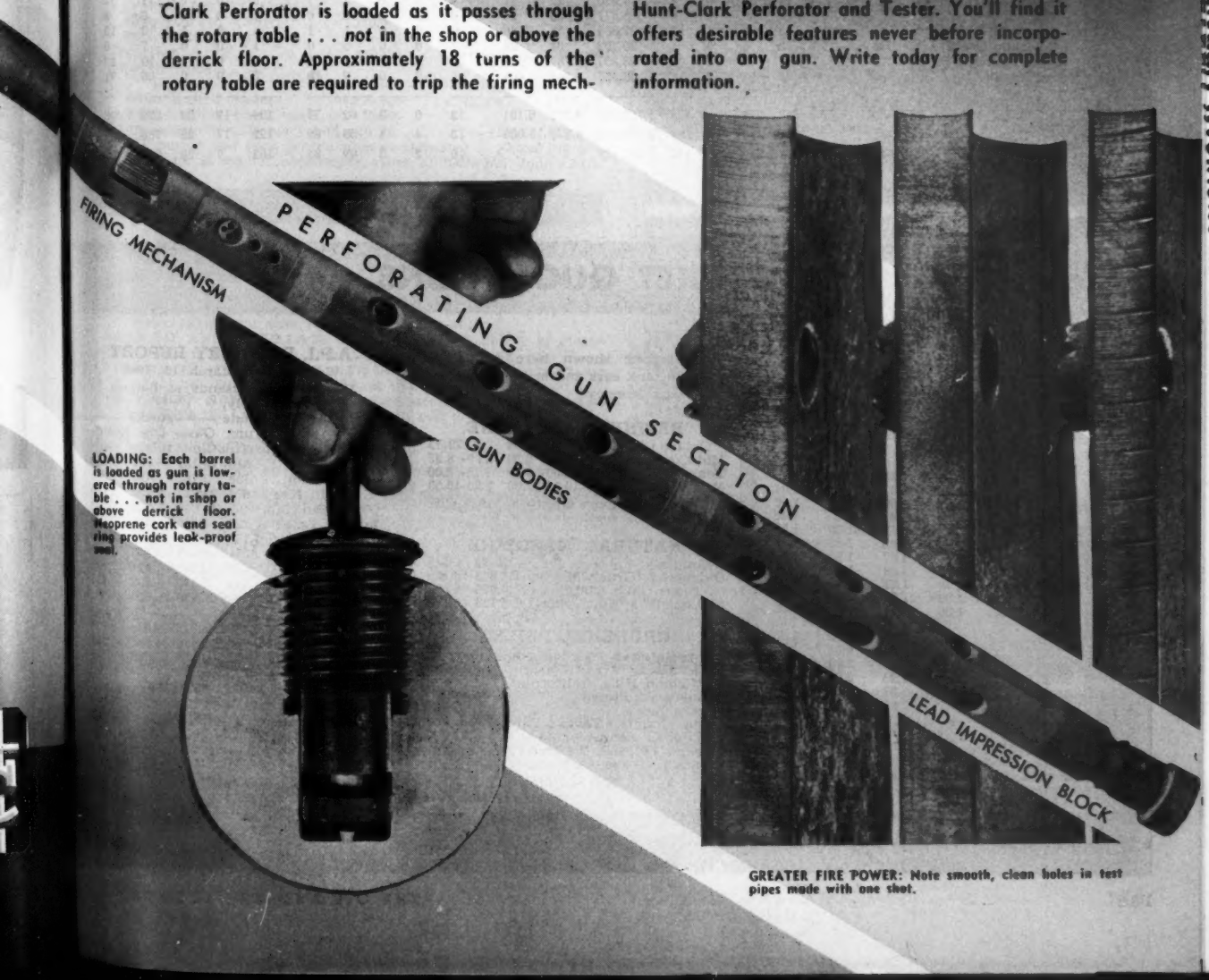
L PERFORATOR AND TESTER

perforating gun ever developed

PLUS A NEW FIRING PRINCIPLE THAT GIVES DEEPER PENETRATION

Design of the new Hunt-Clark Perforator and Tester . . . proved in more than a year of actual field use . . . has set a new standard for safety and efficiency. You can test and perforate and re-test at one trip. It fires in all four directions, one shot every two inches. It provides safety and fire-power never before offered. The mechanically operated multiple shot gun is fired simultaneously by a rotary trip device. Each barrel of the Hunt-Clark Perforator is loaded as it passes through the rotary table . . . *not* in the shop or above the derrick floor. Approximately 18 turns of the rotary table are required to trip the firing mechanism *after* the gun is positioned at the proper depth.

Greater fire-power . . . with deeper penetration . . . is accomplished through the exclusive "boat tail" ogival point bullet. It has less drag . . . greater stability . . . greater striking force . . . makes a cleaner hole. The unique powder charge in the Hunt-Clark Perforator will not flake . . . is moisture-proofed. Check further design of the Hunt-Clark Perforator and Tester. You'll find it offers desirable features never before incorporated into any gun. Write today for complete information.



LOADING: Each barrel is loaded as gun is lowered through rotary table . . . not in shop or above derrick floor. Neoprene cork and seal ring provides leak-proof seal.

GREATER FIRE POWER: Note smooth, clean holes in test pipes made with one shot.

STATISTICS and

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 22, 1947

	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1947				
	Comp.	Oil	Gas	Dry	Footage	1947	1946	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	20	10	0	*10	29,021	311	349	0	0	0	0	0	0	0	0	0	0
Pennsylvania	49	25	1	†23	80,017	724	942	0	0	0	0	0	0	0	0	0	0
West Virginia	16	0	13	3	41,677	193	154	0	0	0	0	0	0	0	0	0	0
Ohio	25	6	14	5	72,089	265	239	0	0	0	1	1	0	0	1	11	12
Indiana	6	1	0	5	12,811	95	65	0	0	0	0	0	1	0	0	6	7
Kentucky	8	4	1	3	13,002	88	93	1	0	0	0	1	1	0	0	8	9
Illinois	39	24	0	15	98,013	434	426	1	0	0	2	3	16	0	0	61	77
Michigan	9	2	1	6	19,213	134	148	0	0	0	3	3	1	0	3	52	56
Kansas	51	25	11	‡15	164,062	584	468	2	0	0	3	5	10	0	6	65	81
Neb., Mo., Iowa	0	0	0	0	0	2	4	0	0	0	0	0	0	0	0	2	2
Oklahoma	58	27	5	26	160,463	897	548	0	0	0	13	13	21	0	2	166	189
Texas	150	102	13	35	677,035	1,792	1,746	6	0	3	22	31	61	11	17	282	371
North Central (Dist. 7B & 9)	41	29	1	11	111,340	546	600	2	0	1	5	8	27	0	5	99	131
West (Dist. 7C & 8)	34	28	1	5	169,551	447	374	1	0	1	2	4	6	0	2	36	44
Panhandle (Dist. 10)	11	2	9	0	37,363	103	86	0	0	0	0	0	1	0	0	0	1
Eastern (Dist. 5 & 6)	7	3	2	2	41,129	102	167	0	0	1	1	2	1	0	1	25	27
Gulf Coast (Dist. 3)	31	23	0	8	192,358	344	398	2	0	0	5	7	14	7	8	58	87
Southwest (Dist. 1, 2 & 4)	26	17	0	9	125,294	250	121	1	0	0	9	10	12	4	1	64	81
Louisiana	19	10	0	9	113,889	246	278	1	0	0	5	6	11	6	0	34	51
Northern	10	5	0	5	28,707	116	143	0	0	0	4	4	0	0	0	20	20
Southern	9	5	0	4	85,182	130	135	1	0	0	1	2	11	0	0	14	31
Arkansas	7	3	1	3	35,999	49	37	0	0	0	1	1	0	0	0	7	7
Mississippi	7	7	0	0	53,471	78	54	0	0	0	0	0	0	0	1	19	20
Southeastern States	1	0	0	1	4,010	12	11	0	0	0	1	1	0	0	0	11	11
Montana	2	0	2	0	3,571	38	55	0	0	0	0	0	0	0	0	8	8
Wyoming	5	3	1	1	32,368	53	46	0	0	0	1	1	4	0	1	10	15
Colorado-Utah	3	2	0	1	20,402	34	26	0	0	0	0	0	1	0	0	7	8
New Mexico	7	6	0	1	28,397	107	88	0	0	0	1	1	2	0	1	10	13
California	26	15	0	11	98,557	442	404	1	0	0	9	10	5	0	0	66	71
Total United States	508	272	63	173	1,758,087	6,578	6,181	12	0	3	62	77	134	17	32	825	1,008
Total previous week	548	312	55	181	1,973,676	6,070	5,650	13	4	4	59	80	122	17	29	763	931
Total March 23, 1946	531	299	45	187	1,787,417			10	2	3	69	84	102	7	28	690	827

Service wells included: *10, †22, ‡1.

MARKET QUOTATIONS

GRAVITY SCHEDULES

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$1.40	....	....	....
19-19.9	1.45	....	....	....
20-20.9	1.49	$1.55	....	$1.42
21-21.9	1.53	1.57	....	1.44
22-22.9	1.57	1.59	....	1.46
23-23.9	1.60	1.61	....	1.48
24-24.9	1.64	1.63	$1.86	1.50
25-25.9	1.68	1.65	1.88	1.52
26-26.9	1.71	1.67	1.90	1.54
27-27.9	1.75	1.69	1.92	1.56
28-28.9	1.79	1.71	1.94	1.58
29-29.9	1.82	1.73	1.96	1.60
30-30.9	1.86	1.75	1.98	1.62
31-31.9	....	1.77	2.00	1.64
32-32.9	....	1.79	2.02	1.66
33-33.9	....	1.81	2.04	1.68
34-34.9	....	1.83	2.06	1.70
35-35.9	....	1.85	2.08	1.72
36-36.9	....	1.87	2.10	1.74
37-37.9	....	1.89	2.12	1.76
38-38.9	....	1.91	2.14	1.78
39-39.9	....	1.93	2.16	1.80
40 and above	....	1.95	2.18	1.82

*For crude from Daboval, El Campo, and Sandy Point. †Includes Lea County, New Mexico.

(Quotations shown here are f.o.b. plant in tank cars and in cents per gal. as of last Monday.

REFINERY GASOLINE

Octane (A.S.T.M.)	78-80†	73-75
Mid-Continent*	8.75- 9.25	8.00- 8.25
Texas Gulf Coast	8.50- 9.00	7.75- 8.00
New York Harbor	10.20-12.00	9.20-10.50

*Basic Oklahoma Group 3. †1939 C.F. R. (research method).

NATURAL GASOLINE

Grades—	26-70	18-55
Oklahoma (Group 3)	5.375	6.450
N. Texas (f.o.b. plant)	4.875	5.850
N. Louisiana (f.o.b. plant)	5.125	6.150

CRUDE-OIL PRICES

Representative posted schedules per bbl.

East Texas	$1.95
Kettleman Hills, California*	1.94
Beauregard Parish	1.90
Illinois Basin	2.07
Pecos County, Texas (Yates)	1.65
Bradford, Pennsylvania	3.65
Eastern Ill. and Western Ind.†	2.07
Tomball, Texas Gulf Coast	2.10

*37°-37.9°. †35° and above.

A.P.I. REFINERY REPORT

Week ended March 15, 1947

Figures in thousands of barrels

	Dly. crude runs to stills	stocks— Gasoline	Distillate	Residual
East Coast	810	23,137	9,931	6,489
Appalachian	158	3,722	446	282
Ill., Ind., Ky.	874	22,225	2,450	2,149
Okla., Kan., Mo.	407	10,648	1,233	903
Inland Texas	226	4,668	310	779
Tex. Gulf Cst.	1,158	15,834	6,460	5,118
La. Gulf Cst.	341	5,237	2,113	1,515
N. La., Ark.	65	2,252	421	126
Rocky Mtn.	134	3,161	502	781
California	813	15,929	10,518	25,592
Total 3-15-47	4,986	106,813	34,384	43,734
Total 3- 8-47	4,935	106,418	36,601	44,202
Total 3-16-46	4,614	104,735	26,588	37,746

CRUDE-OIL STOCKS

(Bureau of Mines Estimate)

Week ended:	Bbl. of crude*
March 15, 1947	222,341,000
March 8, 1947	223,679,000
March 16, 1945	226,233,000

*Excludes unrefinable Calif. stocks.

TRENDS

DAILY AVERAGE PRODUCTION FOR WEEK

	Mar. 22 crude oil	B. of M. Mar. demand	Mar. 15 crude oil
Alabama	950	1,200	950
Arkansas	81,400	79,000	79,900
California	912,600	850,000	914,000
Colorado	36,080	38,000	37,250
Eastern	65,800	64,200	57,500
Florida	740	200	0
Illinois	187,100	210,000	190,500
Indiana	18,100	18,000	16,900
Kansas	267,750	270,000	260,700
Kentucky	27,200	29,000	26,800
Louisiana	415,350	400,000	414,050
North Louisiana	103,900	.....	102,600
South Louisiana	311,450	.....	311,450
Michigan	41,165	47,000	42,155
Mississippi	88,345	77,000	83,345
Montana	22,640	24,000	22,780
Nebraska	650	700	650
New Mexico	103,900	101,000	103,900
Oklahoma	367,850	375,000	367,450
Texas	2,129,750	2,060,000	2,129,750
District 1 (Southwest)	20,550	.....	20,550
District 2 (Southwest)	157,900	.....	157,900
District 4 (Southwest)	242,000	.....	242,000
District 3 (Gulf Coast)	487,300	.....	487,300
District 5 (Eastern)	38,290	.....	38,290
District 6 (Eastern)	110,995	.....	110,995
East Texas field	313,000	.....	313,000
District 7-C (West)	34,890	.....	34,890
District 8 (West)	473,725	.....	473,725
District 7-B (W. Central)	36,425	.....	36,425
District 9 (N. Central)	130,000	.....	130,000
District 10 (Panhandle)	84,675	.....	84,675
Wyoming	109,430	100,000	104,770
Miscellaneous	....	700	
Total United States	*4,876,800	4,745,000	4,853,940
Change from prev. week, up 22,860			

Total production, January 1-March 22 ..... †386,474,495 bbl.
Same period last year (crude plus condensate).. 379,507,270 bbl.
*Not incl. 25,000 bbl. condensate. †Incl. 2,073,080 bbl. condensate.

CRUDE-OIL STOCKS 222,341,000 bbl. as of March 15—down 1,338,000 bbl. One year ago 226,233,000 bbl.

GASOLINE STOCKS 106,813,000 bbl. as of March 15—up 395,000 bbl. One year ago 104,735,000 bbl.

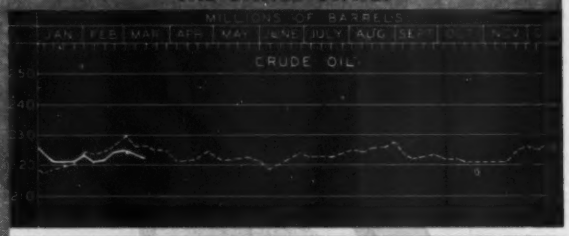
RESIDUAL FUEL-OIL STOCKS 43,734,000 bbl. as of March 15—down 468,000 bbl. One year ago 37,746,000 bbl.

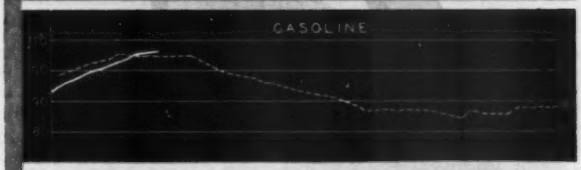
GAS OIL AND DISTILLATE STOCKS 34,384,000 bbl. as of March 15—down 2,217,000 bbl. One year ago 26,588,000 bbl.

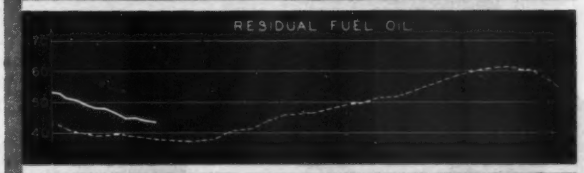
CRUDE-OIL PRODUCTION 4,876,800 bbl. as of March 22—up 22,860 bbl. One year ago 4,423,200 bbl.

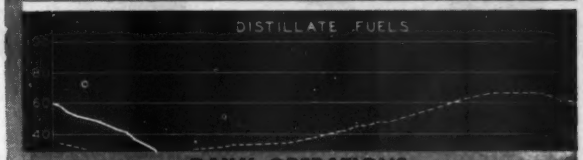
REFINERY RUNS 4,986,000 bbl. daily week ended March 15—up 51,000 bbl. One year ago 4,614,000 bbl.

OIL STOCKS IN THE UNITED STATES

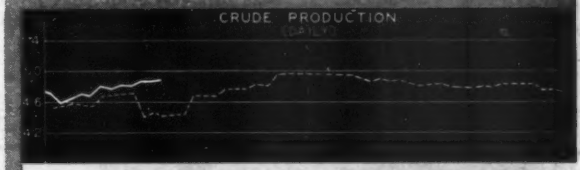


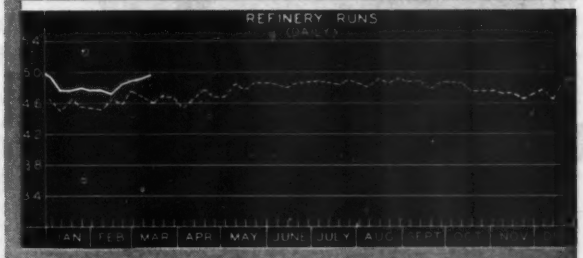




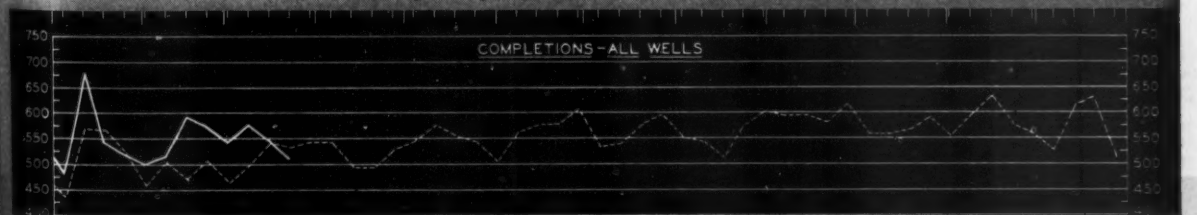


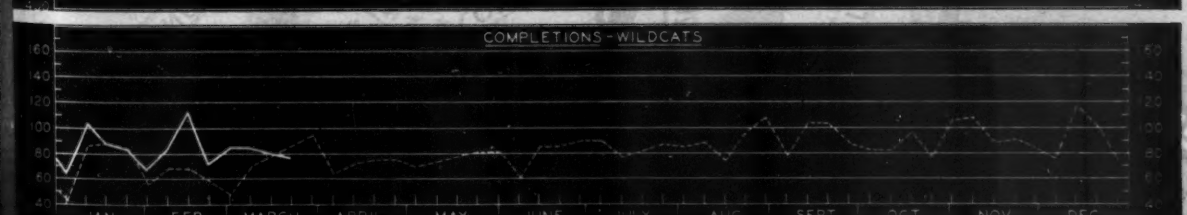
DAILY OPERATIONS





Solid line charts weekly completions, service wells in Eastern area included.





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Exploration and Drilling

Inner Basin Exploration

ANNOUNCEMENT that a deep, inner-basin test will be started, probably in 35-53n-72w, about 18 miles north of Gillette, Campbell County, Wyoming, focuses attention on the Powder River basin. The well will be drilled by the Texas Co. for a unit-operation group, on a block of about 40,000 acres, and is scheduled for 13,000 ft. or better depth.

The news of this test, coming just before the joint meeting of the three exploration societies in Los Angeles, emphasizes how much there is still to be learned about the how and why of oil accumulations and their successful discovery.

The Powder River basin occupies the northeastern part of Wyoming and the southeastern part of Montana. As presently conceived by the geologists, it covers about 32,000 sq. miles, lying between the Big Horn Mountains on the west and the Black Hills of South Dakota on the east. On the south it is marked by a curving rim of oil fields, from Salt Creek on the northwest to Big Muddy to Lance Creek. On the north it extends somewhere north of Miles City in Custer County, Montana; on the northeast it is probably bounded by the huge regional anticline known as the Glendive-Baker or sometimes as Cedar Creek.

Rim structures on the south have produced oil in a few places. Among them, Salt Creek, the giant of all Wyoming fields, has produced over 300 million barrels to date; Big Muddy has produced about 30 million, and Lance Creek has produced about 70 million. Osage, a stratigraphic trap near the east side, has produced about 6 million barrels, and the not far distant Mush Creek appears to be in for a development of as yet unknown size, but probably another stratigraphic trap. Oil seeps have been known since pioneer days on all sides of the basin.

Yet to date, no other area in Wyoming has been so disappointing in relationship to its early promise as has the Powder River basin since Salt Creek was found. Prior to the development of geophysical techniques, inner-basin testing was extremely hazardous, because of the difficulty of detecting structures on a surface covered largely by late Upper Cretaceous and Eocene Tertiary freshwater sediments.

Probably the success of two inner-basin strikes in the Big Horn basin and another in the Green River basin is responsible for starting the test in the interior of the Powder River basin at this time. Geophysical crews have been working in the area in increasing numbers for the past few years, just as they have been in the other major basins of the Rocky Mountain area.

The current test is located on what is known as the Adon structure, a north-south-trending anticlinal feature, about 18 miles long, and typically Rocky Mountain, in that it is rather narrow. There has been a great deal of blocking done in this part of the basin, and one success would result in immediate testing of several of these blocks.

EASTERN TEXAS

Standard of Texas Gets Gas, Another Test Due

DALLAS.—New perforations at Standard of Texas 1 New Birmingham Development Co., 2½ miles northwest of Maydelle, in Cherokee County, in the Bacon limestone at 8,638-52 ft., produced a gas flow of from 238,000 to 380,000 cu. ft. per day, with no free distillate. Packer was set at 8,604 ft., and flow was through ⅜-in. choke on bottom and ⅞-in. on top. Operators planned to pull the tool to the top of the limestone at 8,608-30 ft. for another test before acidizing. In the same county, 5 miles northeast of Gallatin, Delta Drilling Co. 1 Frances Lester was last reported below 7,946 ft. in anhydrite and shale. Tentative base of the massive anhydrite was set at 7,890-7,900 ft.

The Texas Co. 1 W. M. White, deep test in Freestone County, 3 miles west of Fairfield, was milling on junk at 13,326 ft. Total depth is 13,508 ft., with drill pipe stuck 35 ft. off bottom.

In Harrison County, Arkansas Fuel Co. 1 McCauley, 10 miles east of Marshall, was drilling below 5,620 ft. in shale and limestone. Cores to 5,280 ft. recovered thick streaks of shale and scattered oolites. A drill-stem test at 5,296-5,313 ft., open 30 minutes, had a good steady blow but no surface pressure. Recovery was 240 ft. of gas and oil-cut mud, very salty at bottom. Bottom-hole pressure 415 lb.

In Houston County, 6 miles southeast of Grapeland, Magnolia Petroleum Co. 1 J. W. Grounds was drilling below 8,232 ft. in shale and limestone. Humble Oil & Refining Co. 1 P. H. McKnight, 1 mile north of Woodbine production at Hawkins, was below 11,991 ft. in shale with streaks of hard sand.

Glassell & Glassell, Shreveport independents, last week applied to the Texas Railroad Commission for permits to start a nine-well drilling program in Carthage field, Panola County. Locations are from 5 to 7 miles east of Carthage townsite in the W. C. Grey, M. S. Potts, P. M. May, M. Shooks and S. J. Holt surveys.

EAST TEXAS SUCCESSFUL WILDCAT

Anderson County: Blue Bird Investment 1 J. H. Pearson, John Gossett Sur., 5 mi. SW Elkhart, gas well, initial production estimated at 132,000,000 cu. ft. gas a day, open flow, made 4 bbl. distillate per 1,000,000 cu. ft., gas pay 5,503-18 ft., TD 5,705 ft.

EAST TEXAS WILDCAT FAILURE

Harrison County: C. H. Murphy, Jr. 1 M. L. Matthews, G. Martin Sur., 10 mi. S Marshall, dry, TD 7,258 ft., no shows, sample tops: Pettit 6,470 ft.; Travis Peak 6,661 ft., elev. 387 ft.

SOUTH LOUISIANA

Terrebonne Parish Test Completed at 10,720 Ft.

NEW ORLEANS.—A 4,000-ft. extension to oil production in the Lirette field area of Terrebonne Parish, Union Producing Co. 1 Laterre Co., Inc., 35-19s-19e, is being tested. Hole was drilled to a total depth of 11,600 ft., and 7-in. casing cemented at 10,720 ft. for completion. The new well is 5,300 ft. east of gas production and 4,000 ft. northeast of oil production in the area. No. 2 Laterre has been located 6,800 ft. southwest of the No. 1, in 40-19s-19e. This test is to be drilled to 12,000 ft.

Magnolia Petroleum Co. 1-C Lutcher, gas discovery well 4 miles northeast of Mud Lake gas-condensate field in Cameron Parish, 24-14s-11w, gaged 17½ bbl. of condensate, 43.5° gravity, daily along with 3,907,000 cu. ft. of gas daily through a 12/64-in. choke. Flowing pressure on the tubing 3,740 lb., and a shut-in pressure of 4,700 lb. Total depth is 11,705 ft., and production is through perforations at 11,272-309 ft.

Irwin & Hudson et al 3-C J. R. Trumps, 38-9s-1w, north outpost test on the west side of Egan field in Acadia Parish, is cleaning for completion. It flowed at the rate of 10 bbl. of oil hourly through a ⅛-in. choke with 1,700-lb. flowing pressure on tubing and an estimated gas ratio of 570. Production is from the Camerina sands at 10,046-94 ft. Total depth is 10,094 ft. Perforations are from 10,085-090 ft.

Falcon Seaboard Co. et al 1 Willie Lopez, deep wildcat test located 5 miles northeast of Jefferson Island field in Iberia Parish, 1-12s-5e, has been completed dry and had no shows to a total depth of 11,608 ft.

There were 14 new locations reported this week, 2 being wildcats, 1 each in Cameron and Lafayette parishes. There were five oil wells and four dry holes completed this week. One new oil pay in Longville pool, Beauregard Parish, and one dry hole in Assumption Parish were the

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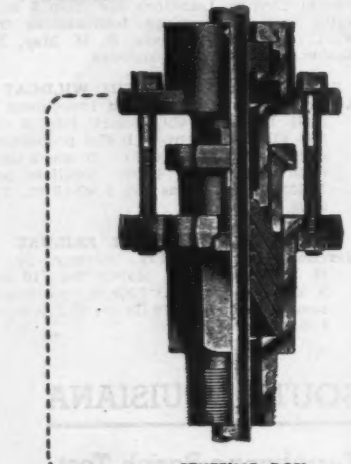

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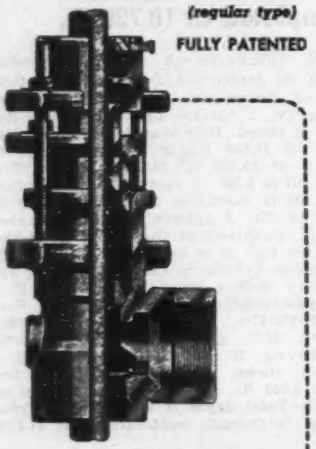

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exploratory tests completed. Terrebonne and Beauregard parishes each received two completions while Assumption, Iberia, Jefferson, Lafourche, and Plaquemines parishes each received one completion.

SOUTH LOUISIANA SUCCESSFUL WILDCAT

Beauregard Parish: New oil pay, Longville pool—Barnsdall 2 Long Bell Lbr. Co., 1-6s-10w, TD 9,001 ft., PB 8,583 ft., sand 8,570-86 ft., Cockfield, open hole 8,570-83 ft., IP: 166 bbl. through 10/64-in. choke, gas-oil ratio 1,056 ft., TP 1,000 lb., CP 1,100 lb., gravity 49.9°.

SOUTH LOUISIANA WILDCAT FAILURE

Assumption Parish: Superior 1 Arthur Schexneyder, 46-12s-13e, SW flank of Napoleonville dome, dry, TD 7,850 ft.

PERMIAN BASIN

New Discovery Reported In Crockett County

MIDLAND.—Cities Service Oil Co. et al 1-B Owen, between Olson and Clara Couch San Andres fields in Crockett County was reported to have blown out and gone out of control after showing for a discovery in the Wolfcamp, basal Permian, at 5,621-70 ft. The well was said to be making a strong flow of approximately 40°-gravity oil, accompanied by an estimated 15,000,000 cu. ft. of gas.

A drill-stem test of the Wolfcamp, first thought to be the lower Strawn section of the Pennsylvanian, brought gas to the surface in 2 minutes, at an estimated rate of 500,000 cu. ft. a day. Oil started flowing in 4 minutes, and was allowed to flow into pits for 14 minutes, with a recovery of 615 ft. of fluid, testing 80 per cent oil and the balance wash water. Since correction of this test to the Wolfcamp, the blowout was thought to be in the Crinoidal of the Pennsylvanian.

Location of the discovery is some 15 miles west-southwest of the nearest Crinoidal producers, in the Todd field. Olson field produces from the San Andres section of the Permian at around 2,110 ft., and production at Clara Couch is from the Grayburg around 1,530 ft. and also the San Andres, averaging 2,220 ft.

In Crane County, Gulf Oil Corp. 1-HH University, Section 3, Block 31, University lands, 3 miles north of Devonian and Silurian production in Block 31 field, was coring ahead to the Ellenburger. A 60-minute drill-stem test of the Waddell at 10,339-74 ft. brought gas to the surface in 10 minutes, gaged at 108,000 cu. ft., and recovered 560 ft. of 43°-gravity oil, and 325 ft. of heavily oil-cut mud.

In Crane County, The Texas Co. 31 Connell, 3 miles west of Jordon field, topped the Tubb zone at 4,450 ft. A 2½-hour drill-stem test at 5,438-87 ft. brought gas to the surface in 70 minutes, recovering 455 ft. of oil and gas-cut mud and 120 ft. of salt water. Operators were drilling ahead below 5,520 ft., going to the Ellenburger. Previously this test had shows of oil in the Glorietta, recovering 1,900 ft. of oil and 300 ft. of sulfur water on a drill-stem test at 4,660-4,740 ft.

WEST TEXAS SUCCESSFUL WILDCATS

Crockett County: T. W. & J. M. Loffland 1-A V. B. Cox, Sec. 40, Blk. ST, TCRR Sur., west central part of county, pumped 25 bbl. of 28°-gravity oil, limestone pay 1,014 ft., TD 1,137 ft.

Ledge Petroleum Co. 1-A G. Bouscaren, Sec. 25, Blk. GG, HE&WT Sur., ½ mi. E of Noelke field, gas well, flowed 20,000,000 cu. ft. gas a day, shut-in casing pressure 1,075 lb., gas sand 2,116 ft., TD 4,235 ft., PB 2,156 ft.

WEST TEXAS WILDCAT FAILURES

Borden County: Thos. W. Boswell 1 R. H. Cantrill, Sec. 22, Blk. 32, ELRR Sur., NW cor. of county, dry, TD 5,025 ft., anhydrite 1,510 ft., Yates 2,130 ft., San Andres 3,400 ft., elev. 2,956 ft.

Winkler County: Santa Fe Petroleum 1 R. A. Wheeler, Sec. 21, Blk. B-6, PSL Sur., 7½ mi. SE Keystone Ellenburger field, dry, TD 11,980 ft. in dolomite, Yates 2,650 ft., San Andres 4,120 ft., Glorietta 5,360 ft., Clear Fork 5,730 ft., Tubb sand 6,280 ft., base Permian 8,090 ft., Mississippi limestone 8,595 ft., Devonian 9,620 ft., Silurian 9,805 ft., Simpson 10,730 ft., Waddell 11,495 ft., Ellenburger 11,895 ft., elev. 2,950 ft.

SOUTHEASTERN NEW MEXICO

HOBBS.—In Chavez County, Kerr-McGee Oil Industries 1 Reid, 8-13s-30e, about 9 miles west of Caprock field, was running casing at total depth of 2,971 ft. Fluid stood some 1,500 ft. in the hole and some oil was reported at 2,950-76 ft.

In Eddy County, E. Orcutt 2 Kepple, 19-17s-27e, between Empire and Red Lake, set 2-in. tubing at 1,815 ft. and was swabbing an estimated 20 bbl. of oil a day. Total depth was 1,903 ft., plugged back to 1,815 ft.

The Texas Co. 1 Garrett, 22-16s-38e, Lea County, 8 miles northeast of Lovington field, plugged back from 5,710 ft. to test the San Andres at 5,690 ft. Casing was set at 5,540 ft. and perforated at 5,300-5,400 ft. with 6 shots per foot. Texas 1-AK State, 16-16s-39e, ¾ mile northwest of the 1 Garrett, was drilling below 4,700 ft. in anhydrite.

SOUTHEASTERN NEW MEXICO WILDCAT FAILURE

Eddy County: Richfield Oil 1 Lake McMillan unit, NW SE 36-20s-26e, dry, TD 6,020 ft., electric tops: Red sand 1,090 ft., San Andres 1,690 ft., Bone Springs 3,170 ft., elev. 3,248 ft.

MICHIGAN

Gas Wells To Feature Increased Operations

SAGINAW.—The state conservation department issued 31 drilling permits in the past week, 15 of them for natural gas activities in connection with plans to develop storage facilities in the Clare-Mecosta area. Field operations meanwhile resulted in 9 completions, including 2 oil wells, a small natural gas well and 6 dry holes of which 3 were wildcats. Ohio Oil Co. announced it was abandoning its deep test in Section 29, Lincoln township, Osceola County. Drilling failed to show results at 5,030 ft. The project was to test levels below the Reed City field production horizon.

Nine of the drilling permits are for locations in Clare County, six in Newaygo, two in Missaukee, one each in Arenac, Van Buren, Allegan, Kalamazoo, Ottawa, Crawford and Montcalm.

Mogul Oil Co. reported its 1 Dent in Section 5, Sherman township, Isabella County, flowed 153 bbl. on quarter-inch choke in 18 hours after acid treatment. The other producer was Ervin Mahor 1 Currier in Section 33, Arbela township, Tuscola County, which rated 15 bbl. a day after acidizing.

MICHIGAN WILDCAT FAILURES

Arenac County, Adams Township: Don F. Rayburn 1 Otis Mutch, NW SE NW 1-19n-3e; dry in Dundee; TD 3,067 ft.

Clinton County, Riley Township: Charles W. Teater 1 Emma Belle Jones, NE NE NW 2-6n-3w; dry in Traverse Limestone; TD 2,495 ft.

Ottawa County, Zeeland Township: Tri-County Development Co. 1 John and Reka Miedema, C-SE NW 1-5n-14w; dry in Berea; TD 930 ft.

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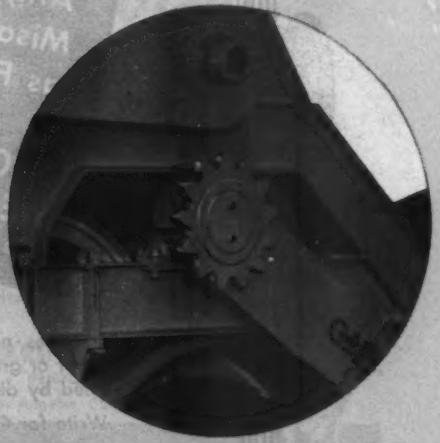

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TEXAS GULF COAST

Refugio County Discovery Gages 155 Bbl. Pipe-Line Oil

HOUSTON. — Hewit & Dougherty 1-A Kathleen D. Roache, a new field discovery in Refugio County, 4 miles southwest of Woodsboro and 3¾ miles northwest of La Rosa field, on potential test gaged 155 bbl. of 38.5°-gravity pipe-line oil per day through a ⅛-in. choke, with gas-oil ratio of 1,263. Production is through perforations at 6,814-18 ft., tubing pressure 1,500 lb., and casing pressure 2,500 lb. Total depth is 6,818 ft., with top of the pay sand at 6,809 ft. This new discovery is located in the Atkins & O'Niel subdivision of the Roache tract in D. J. Mitchell Survey. Operators now have spudded their 2-A Kathleen D. Roache, 933 ft. northeast of the 1-A discovery well.

Also in Refugio County, Clymore Co., Inc., 2 John F. Zarsky, discovery well of Wyrick field, in the John & Pugh subdivision of Bonnie View ranch, flowed a potential of 126 bbl. of 40.7°-gravity oil per day through a ⅛-in. choke, with gas-oil ratio of 288. Perforations at 4,946-48 ft., tubing pressure 525 lb., casing 1,250 lb., with no water in the flow. Total depth is 6,395 ft. with 5½-in. casing set to 5,908 ft. and sand topped at 4,944 ft. This well is 933 ft. north of the 1 Zarsky, original gas discovery well in this area.

A new deeper pay zone has been opened in Burnell-Wilcox field, Karnes County, by Stanolind Oil & Gas Co. 1 E. P. Ruhman, Sr. Located in James Johnson Survey, Abstract 614, this well was drilled to a total depth of 8,520 ft., with 7-in. casing at 8,514 ft. The well is producing through perforations in the Wilcox sand at 6,966-70 ft., flowing 152 bbl. of 39°-gravity pipe-line oil per day through a 9/64-in. choke, with gas-oil ratio 493, no water in the flow. The Slick sand tested oil at 6,682-88 ft., but no production test was made.

Cockburn Oil Corp. 1 Wharton Bank & Trust Co., a wildcat test 3 miles south of Lane City townsite, 3½ miles northeast of Withers field production, Wharton County, flowed 2,000,000 cu. ft. of gas with a spray of condensate daily through a ¼-in. choke with 2,000-lb. flowing pressure. Total depth is 5,650 ft., and 5½-in. casing is cemented to 4,600 ft. A second test for the discovery area, which will be called Prasifka field, will be approximately 1,500 ft. to the southwest.

Also in Wharton County, Wirt Franklin Petroleum Corp. 1 E. J. Steves, wildcat gas discovery 2 miles north of Louise gas field, in J. J. Dillard Survey, Abstract 18, has been shut in and awaits potential gage. This well flowed gas through perforations at 6,354-58 ft. with 2,450-lb. flowing pressure on the tubing through a 15/64-in. choke. Total depth is 6,508 ft. with 5½-in. casing cemented at 6,497 ft.

Gas production at North Delhi pool, Harris County, has been extended ½ mile to the west. Humble Oil & Refining Co. 1 North Delhi unit 4, in H&TC Survey, Section 46, Block 2, Abstract 44, gaged 2,863,000 cu. ft. of gas daily through a ¼-in. choke through perforations at 7,060-69 ft. Total depth is 7,108 ft., and the 5-in. casing was cemented 4 ft. off bottom.

There were 32 new locations reported this week, 5 being wildcats, 2 in Wharton and 1 each in Harris, Orange, and Wilson counties. Refugio County received the greatest activity this week with six new starts. Wharton County received four new locations. The 31 completions included 23 oil and 8 dry holes, with 2 new pays, 1 each in Stratton Ridge field, Brazoria County, and Burnell-Wilcox field in Karnes County, while one new oil pool was opened in Refugio County. Five wildcats were dry, 1 each in DeWitt, Lavaca, Live Oak, Refugio, and Victoria counties.

TEXAS GULF COAST SUCCESSFUL WILDCATS

Brazoria County: New oil pay, Stratton Ridge field—E. Cockrell 5 Seaburn estate heirs, in Jared E. Groce 5 Lge. Gr., OWDD—original TD 4,660 ft., new TD 4,986 ft., top sand 4,962 ft., open hole 4,965-86 ft., IP: 130 bbl. per day, through 9/64-in. choke, gas-oil ratio 392, TP 610 lb., CP 1,150 lb., gravity 29.2°, no water.

Karnes County: New oil pay, Burnell-Wilcox field—Stanolind 1 E. P. Ruhman, Sr., James Johnson Sur., top pay 6,966 ft., TD 8,520 ft., perf. 6,966-70 ft., IP: 152 bbl. oil per day through a 9/64-in. choke, gas-oil ratio 493, TP 760 lb., CP 1,575 lb., gravity 39°, no water.

Refugio County: New oil pool—Hewit & Dougherty 1-A Kathleen D. Roache, D. J. Mitchell Sur., 4 mi. SW of Woodsboro, and 3¾ mi. NW of La Rosa field, TD 6,818 ft., top pay 6,809 ft., perf. 6,814-18 ft., IP: 155 bbl. oil per day through a ⅛-in. choke, gas-oil ratio 1,263, TP 1,500 lb., CP 2,500 lb., gravity 38.5°, no water.

TEXAS GULF COAST WILDCAT FEATURES

DeWitt County: Hunt Oil Co. 1 Alfred Friar, in John Dawly Sur., 7 mi. E of Cuero, 6 mi. N of Thomaston field, dry, TD 8,263 ft.

Lavaca County: Barnsdall Oil Co. 1 Joe Matula, Vincent Meyers Sur. A-322, 8 mi. SE of Hallettsville, dry, TD 10,006 ft.

Live Oak County: Smith-Story-Wood Corp. and Skinner & Eddy Corp. 1 Eva Pugh, Eduardo Ramirez Sur. 15, 4 mi. SW of Mikeska, dry, TD 4,105 ft.

Refugio County: Mackhank Pet. Co. 1-B F. V. W. Heard, Est., Mary and Ann Roach Sur., 4 mi. W of Refugio, dry, TD 6,704 ft.

Victoria County: Sunray Oil Corp. 9-A J. A. McFaddin Est., Francisco Ramon Sur. A-95, 4 mi. W of North McFaddin field, dry, TD 6,310 ft.

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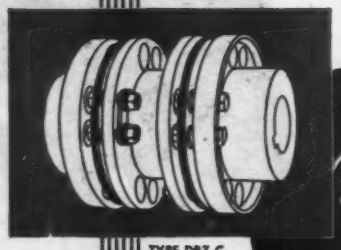

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SOUTHWEST TEXAS

Caldwell County Discovery Pumps 67 Bbl. Daily

CORPUS CHRISTI.—J. G. Pundt et al 1 C. F. Richardson et al, new oilfield discovery in Caldwell County, approximately 5 miles southwest of Lockhart, has been completed for a potential of 67 bbl. of oil per day on pump, gravity 38°, from open hole at 1,608-64 ft. Austin chalk was topped at 1,606 ft. This well is located in Andrew Churchill Survey, Abstract 66. Operators now are drilling 2 Richards, 660 ft. north of the No. 1.

Southern Minerals Corp. 1 S. B. Alley, oil discovery well about 1½ miles west of Alice field, in Jim Wells County, jetted 7 to 8 bbl. of oil per day while testing through perforations at 5,045-55 ft. Operators are now installing gas-lift equipment after acidizing the perforations with 1,000 gal. of acid. This well is located in the L. G. Collins farm lots, Lot 23, 6 miles southwest of Alice townsite.

Oil discovery well in the CAM field, Duval County, B. C. Graham and CAM Corp. 2 Rosa V. de Benavides gaged 75 bbl. of oil per day through a 9/64-in. choke with 165-lb. tubing pressure and 785-lb. casing pressure, gravity 39°, no water. Production is through perforations at 2,656-64 ft., with 5½-in. casing on bottom, total depth 3,365 ft. This well is in the Mariano Arispe Grant 75, 660 ft. southeast of the 1 Benavides gas discovery well and about 2 miles northeast of O'Hern field. The 1 Benavides was completed at 3,319-25 ft. in the Yegua zone. The 2 well produces from the Government Wells zone. Operators now are preparing to drill 3 Benavides, 660 ft. northeast of the No. 1 well and 933 ft. north of the No. 2 oil discovery for a test of the oil pay.

Republic Natural Gas Co. 1 Charles L. Scott, oil discovery well in the La Gloria townsite, Jim Wells County, approximately 2¼ miles north-northeast of the nearest south-flank oil production at La Gloria field. On a drill-stem test through perforations at 6,120-30 ft., open 10 minutes, recovered 525 ft. of pipe-line oil with 10-lb. working pressure. Total depth is 6,200 ft. with 5½-in. casing on bottom. Operators are now preparing to complete the well. There is an indication that this production may link up with the east side of the south-flank oil production at La-Gloria to effect a 2¼-mile extension of this production.

There were 39 new locations this week with 9 being wildcat starts, 3 in Duval and 1 each in Atascosa, Bastrop, Kenedy, McMullen, Milam and Webb counties. The 26 completions were 17 oil and 9 dry holes, with 1 successful wildcat which opened a new oil pool in Caldwell County, and 9 dry wildcats, 3 in Starr, 2 in Duval, and 1 each in Atascosa, Edwards, and Webb counties.

SOUTHWEST TEXAS SUCCESSFUL WILDCATS

Caldwell County: New oil pool—J. G. Pundt et al 1 C. F. Richardson et al, Andrew Churchill Sur. A-66, 5 mi. SW of Lockhart, TD 1,664 ft., top pay (Austin chalk) 1,606 ft., open hole 1,606-64 ft., IP: 67 bbl. oil per day on pump, no gas, gravity 38°, no water.

SOUTHWEST TEXAS WILDCAT FAILURES

Atascosa County: Mellie Pegg, Milton Pegg and W. H. Bode 1 Mrs. Josephine Rogers, in J. Conley Sur., 6 mi. N of Poteet, dry, TD 2,362 ft.

Duval County: Continental Oil Co. 2 Clara Driscoll "A" Lse., in Sec. 63, in Subd. of Santa Rosalia (Rafael Ramirez) Gr., 2 mi. NW of Conoco Driscoll field, dry, TD 3,420 ft.

R. H. Hawn 1 Juan Stillman, in La Huerta Gr., 3 mi. NE of Concepcion, dry, TD 6,016 ft.

Edwards County: Dan Auld 1-A Hal and C. V. Peterson, AB&M Sur. 16, Blk. 2, 6 mi. NE of Rock Springs, dry, TD 5,080 ft.

Jim Hogg County: Standard Oil Co. of Kansas 1 Carlotta F de Guerra, in E. J. Foster Subd. of Carlos Guerra ld., Las Cuevitas Gr., 34 mi. S of Hebbronville, and 1½ mi. S of Cuevitas, dry, TD 2,511 ft.

Starr County: L. W. Conner et al 1 Erna Weahrle, in J. H. Slayton Sur., 25 mi. NE of Rio Grande City, 1½ mi. NW of Rincon field, dry, TD 5,510 ft.

Starr County: R. C. Hillman 1 Guerra, Antonio Sanchez Porc. 69, 6 mi. N of Roma, dry, TD 385 ft.

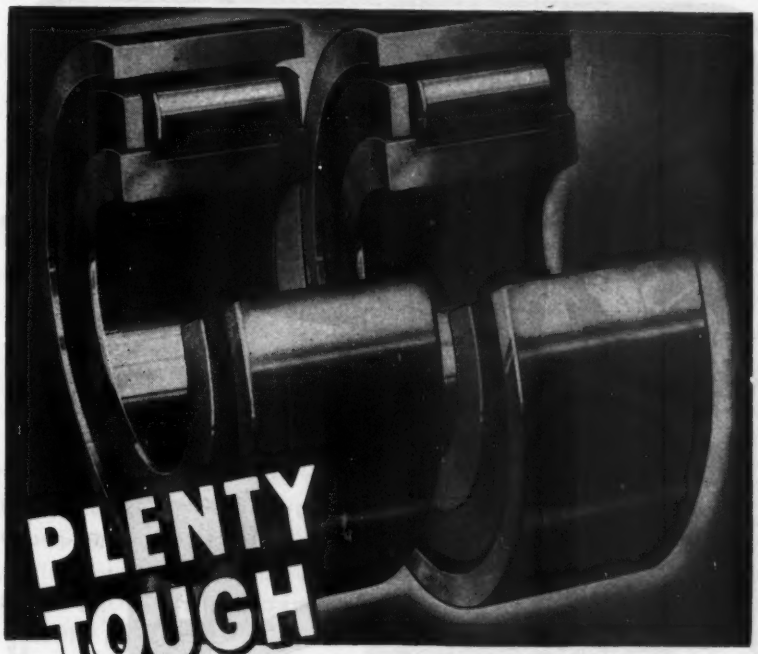
Lockhart & Co. 1 Domingo L. Garza, Sur. 164, 12 mi. NE of Rio Grande City, 5 mi. W of Rincon field and 3½ mi. N of Ross field, dry, TD 5,640 ft.

Webb County: Houser & Campbell 1 E. Garcia Est., Blk. 21, Sur. 592, Los Ojuelos, Gr., 3½ mi. SE of Mirando City, dry, TD 2,510 ft.

APPALACHIAN FIELD

Sylvania Corp. Completes Oriskany Sand Gas Well

PITTSBURGH.—In Summit Township, Erie County, northwest Pennsylvania, Sylvania Corp. cemented the test on Alton F. Hugger farm in the Oriskany sand with a final open flow of 254,000 cu. ft. of gas and a rock pressure of 615 lb. in 24 hours from a total depth of 2,379 ft. From a surface elevation of 1,236 ft., the Tully lime was logged at minus 656 ft., Onondaga lime, minus 885 ft.; Oriskany, minus 1,137 ft. The gas was struck at 2,373-79 ft. where drilling stopped. In the discovery well, the Oriskany was logged at minus 1,129 ft. and gaged 1,400,000 cu. ft. of gas initial. Here, Appalachian Develop-



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ment Co. topped the Tully lime at minus 658 ft. in the test on George S. Garber farm.

In German Township, Fayette County, Carnegie Natural Gas Co. deepened 2 H. C. Frick Coke Co., an Injun sand well reported good for 353,000 cu. ft. of gas, 2,040-47 ft. with an increase in gas to 5,115,000 cu. ft. where drilling halted.

New locations in southwest Pennsylvania totaled 11. They were in Kittanning and Valley townships, Armstrong County; German and Springhill townships, Fayette County; Franklin and Morgan townships, Greene County; North Strabane and Nottingham townships, Washington County, and Bell Township, Westmoreland County.

In Ripley district, Jackson County, West Virginia, Columbian Carbon Co. completed 929 Frank Walters good for 3,170,000 cu. ft. ft. of gas, natural, from the Oriskany sand with the surface elevation 611 ft.; Corniferous lime, 4,680 ft.; Oriskany, 4,785 ft.; gas, 4,786-92 ft., rock pressure 950 lb. in 23 hours; total depth, 4,818 ft. Its No. 933 J. M. Sullivan in Ravenswood district was dry through the Oriskany sand to 5,034 ft.

In Elk district, Kanawha County, the following Oriskany tests are nearing completion: Falling Rock Producing Co., 3 Fred J. Thabet, elevation 1,085 ft., Corniferous lime 5,301 ft. drilling 5,396 ft. Linden Drilling Co. 1 Goshorn Heirs, Corniferous lime 5,064 ft., casing at 5,072 ft.; E. C. Metzner, Inc. 1 J. S. Mason, elevation 799 ft., Corniferous lime 4,902 ft.; A. C. Radford et al 1 J. A. Murdock, elevation 1,145 ft., Corniferous lime 5,565 ft.; United Fuel Gas Co. 5,769 J. E. Carpenter, elevation 1,158 ft., Corniferous lime 5,266 ft., United Fuel Gas 5,799 Laura E. Ross, elevation 920 ft., Corniferous lime 5,055 ft.; United Fuel Gas 5,803 Lewis Hubbard Co., elevation 877 ft., Corniferous lime 5,084 ft.

New locations totaled 15. They were in Falls and Nuttall districts, Fayette County; Washington district, Jackson County; Cabin Creek and Elk districts, Kanawha County; Duval district, Lincoln County; Harvey district, Mingo County; Clear Fork and Trap Hill districts, Raleigh County; Union district, Ritchie County; Grant district, Wayne County; and Union district, Wood County.

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N. CENTRAL TEXAS

Phillips Well Gets New Ellenburger Production

WICHITA FALLS.—New Ellenburger production was discovered in southwestern Cooke County, 2½ miles southeast of the Dangle (Ellenburger) field, and 2 miles west of Hood, by Phillips Petroleum Co. at its 1 L. M. Atcheson, in the J. Davis Survey, A-331. Top of the zone was 2,032 ft.; it was drilled out to 2,064 ft., acidized and flowed at the rate of 30 bbl. of oil an hour through ⅜-in. tubing choke. Oil is 40° gravity.

In northern Grayson County, Denver Producing & Refining Co. 1 Rich, I&GN Survey, was reported drilling ahead below 12,868 ft. in limestone. It is North Texas' deepest test, but formation tops have not been announced.

Fred M. Manning, Inc. 1 R. A. Brown Cattle Co., ½-mile northeast extension to the new Record Mississippi limestone field, set 5½-in. casing at 4,686 ft. and was waiting on cement before making production tests. This well was reported to have shown for production in the Strawn and Caddo as well as the Mississippian, as did the discovery. Top of the Caddo in the extension well was corrected to 4,121 ft., from 4,134 ft.

New Saddle Creek sand production was indicated in Taylor County, 2½ miles west of Merkel, Section 20, Block 18, T&P Survey, at S. B. Roberts 2 L. S. Tipton. With packer set at 2,694 ft., a 20-minute test brought gas to the surface in 6 minutes and recovered 2,000 ft. of clean oil. Total depth is 2,721 ft.

The new Humphrey-Chapman field in Haskell County, 10 miles northeast of the town of Haskell, was given a northeast offset. Mudge Oil Co. made application to drill 1 P. M. Baldwin in Section 64, T. McMeary Survey. It is scheduled to 5,000 ft.

NORTH CENTRAL TEXAS SUCCESSFUL WILDCAT

Cooke County: Benson Bros. 2 F. B. Bordovsky, A. C. C. Bailey Sur., 3 mi. E Gainesville, pumped 5 bbl. a day, pay 2,290-97 ft., TD 2,462 ft.

NORTH CENTRAL TEXAS WILDCAT FAILURES

Clay County: Hedrick Oil Co. 1 Mattie Chapin, Blk. 81, Byers Bros. subd., 3 mi. NW Petrolia, dry, TD 2,074 ft. in limestone.

Cooke County: Paul B. Scott 1 S. P. Meadors, I. S. Fields Sur., 6 mi. NW Muenster, dry, TD 1,804 ft. in porous conglomerate.

Knox County: W. J. & J. J. Moran 1 Nellie Brown, Sec. 172, Blk. 44, H&TC Sur., 3 mi. S Truscott, dry, TD 6,344 ft. in conglomerate, slight show oil 6,341-42 ft.

Montague County: Continental Oil 1 Moss, J. W. Clanton Sur., 4 mi. E Ringgold, dry, TD 5,995 ft., Caddo 5,546 ft., conglomerate 5,683 ft., Ellenburger 5,888 ft., elev. 845 ft.

Wichita County: Consolidated Oil 1 Clara Michna, Wm. Mayer Sur., 3½ mi. SW Wichita Falls, dry, TD 2,106 ft. in shale.

WEST CENTRAL TEXAS SUCCESSFUL WILDCATS

Coleman County: Anzac Oil 1 C. V. Evans, 3 mi. SW Valera, new oil field, Sec. 27, Blk. 1, GH&H Sur., flowed 169 bbl. 44°-gravity oil a day, 20/64-in. choke, casing pressure 200 lb., tubing pressure 50 lb., GOR 810:1, lower Fry sand

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2,853 ft., TD 2,935 ft., estimated 10,000,000 cu. ft. gas in sand 2,853-83 ft.

Palo Pinto County: Ernest Loyd 1 V. D. Laneur, Peter Miller Sur., A-312, 6 mi. W Graford, gas well, flowed 3,500,000 cu. ft. gas a day, shut-in pressure 442 lb., gas sand 1,143-72 ft., TD 1,185 ft.

Throckmorton County: Fred M. Manning 1 Maud Graham "B," Sec. 985, TE&L Sur., 4 mi. N Woodson, Parrott extension, flowed 239 bbl. 41°-gravity oil a day, ¼-in. choke, casing pressure 680 lb., tubing pressure 400 lb., GOR 950:1, limestone pay 3,912-13 ft., TD 3,965 ft.

WEST CENTRAL TEXAS WILDCAT FAILURE

McCulloch County: Guffey Drilling 2 H. R. Stewart, Sec. 140, H&TC Sur., ¾ mi. E Lohn, dry, TD 1,030 ft. in sand.

CALIFORNIA

Blowout Halts California Standard's Deep Test

LOS ANGELES.—Standard Oil Co. of California's deep test near Montalvo in Ventura County, which had drilled to 11,505 ft. in the search for new oil, blew out unexpectedly while tools were being pulled. The well, 2 McGrath, 26-2n-23w, failed to find any indications of oil in the lower formations penetrated and was plugged back to 8,606 ft. to test saturation encountered at that depth. Operators had cleaned out to a total depth of 8,660 ft. when the blowout occurred. The well caught fire immediately, and all equipment was destroyed.

At latest reports, the well was still burning but California Standard officials said that preparations were under way to extinguish the blaze by the use of dynamite. Ford Alexander, demolition expert, was called in from Taft, Calif.

Standard officials were reluctant to conclude that the blowout indicated the discovery of a new gas reservoir but stated that the well would be repaired and testing continued as soon as the fire is extinguished.

California Standard also experienced trouble during the past week at its Kern County wildcat in the Elk Hills area, 24-34R-U.O.N.P.R., 34-30s-23e. A formation test at this well taken at a depth of 2,503-42 ft. resulted in the recovery of 1,500 ft. of clean oil in 30 minutes. During a second test, at a depth of 2,570-2,642 ft., gas came to the surface in 15 minutes and the well blew out. It blew wild only a short time before it was killed, however, and operators are coring ahead below 2,842 ft. at the present time.

British-American Oil Producing Co. 3 Bodger, 22-3s-14w, in the new Alondra field of Los Angeles County, has reached a depth of 8,334 ft. and is believed near the objective sand. An electric log will be run at a depth of 8,900 ft. Several wells have been drilled in this area, but the discovery well is the only producer so far. It is thought that a complicated fault condition exists, and that it may take considerable drilling to determine the exact nature of the reservoir.

Shell Oil Co., Inc., 53-30 K. C. L.-A., wildcat in Ten Section field of Kern County, was delayed when the drill pipe froze at a depth of 13,745 ft. Operators are preparing to cut the pipe at 11,810 ft. in an effort to resume operations. Located in Section 30-30s-26e, the well is being carried below present producing sands in an effort to find new zones below the Stephens.

The Jasmine area of Kern County has attracted new exploratory interest with the announcement of a new wildcat test by Superior Oil Co. The new test will be the 51 Zuinn, 20-25s-27e. Location is about 2 miles west of Pacific Oil & Gas Development Co.'s discovery, the 72-22 Cantleberry. Pacific at present is drilling an outpost to

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its discovery at the 85-23 C. C. M. O., 22-25s-27e. This latter well is bottomed at 2,968 ft. with basement material topped at 2,960 ft. Gray sand with oil spots was logged at 2,725-45 ft., good oil sand at 2,745-78 ft., gray sand at 2,778-2,807 ft., green clay at 2,807-23 ft., and oil sand at 2,852-55 ft.

New locations during the past week totaled 49, a number well above the 37 announced during the previous week but still below the peak of 63 established 2 weeks ago. South Belridge field led in new work with six of the locations. The remaining tests were well scattered throughout the state.

CALIFORNIA SUCCESSFUL WILDCAT

Fresno County, Raisin City Area: Superior Oil Co. 55 Hackala, 32-15s-17e, flowed 144 bbl. per day through 9/64-in. choke, 2.4 per cent water cut, 30.3° gravity, pay zones 6,962-70 ft., 6,994-7,004 ft., and 7,020-34 ft., elev. 180 ft., TD 7,171 ft.

CALIFORNIA WILDCAT FAILURES

Kern County, Arvin Area: Barnes & Shadrick 2 Barlow, 30-31s-30e, dry, elev. 450 ft., top Granite 1,814 ft., TD 1,820 ft.

Cymric Area: Independent Exploration Co. et al 2 Rocco, 18-29s-21e, dry, elev. 978 ft., top Carneros 1,795 ft., TD 2,196 ft.

Kings County, Reef Ridge Area: Kings Exploration Co. 1 Avenal, 18-23s-17e, dry, elev. 1,521 ft., TD 5,236 ft.

Los Angeles County, North Whittier Area: Bishop 1 Baldwin, 3-2s-11w, dry, TD 3,642 ft.

Canoga Park Area: Vincent F. Stabeck 2 Knapp, 4-1n-17w, dry, TD 765 ft.

Orange County, Fairview Area: Bandini Petroleum Corp. 1 Segerstrom, 34-5s-10w, dry, elev. 32 ft., TD 6,927 ft.

Solano County, Potrero Hills Area: National Investors Fund, Inc., 1 Burke & Donohoe, dry, elev. 5 ft., TD 2,249 ft.

Tulare County, Earlimart Area: Superior Oil Co. 24-22 Day, 22-23s-26e, dry, elev. 380 ft., TD 4,173 ft.

Ventura County, Rincon Area: Honolulu Oil Corp. 1 Signal-Bates, 36-4n-25w, dry, elev. 1,125 ft., TD 6,381 ft.

ROCKY MOUNTAIN

San Juan Basin Test Flows 3 Bbl. Distillate Hourly

DENVER.—The San Juan basin test of Paul B. English and Byrd-Frost, Inc., in 1 Government, NW SW 4-27n-10w, Kutz Canyon district, San Juan County, New Mexico, took on a more promising complexion the past week upon drilling deeper. A sand identified as Dakota was topped at 6,485 ft. which had good showings of oil and gas, but the sand was so impregnated with shale that it gave little evidence of making a well. Some doubts arose as to whether this really was the Dakota, and drilling was resumed.

As a result, the geology has been completely revised. It now appears that this sand was a phase of the lower Mancos. The top of another sand, tentatively identified as the Muddy, which lies just above the Dakota, was picked up at 6,573 ft. Approximately 50 ft. of sand and 52 ft. of shale and coal were drilled when another sand was encountered at 6,676 ft. Drilling continued to 6,721 ft., present total depth, 45 ft. into the sand, which has been identified as the true Dakota. A drill-stem test at 6,450-6,694 ft., open 4 hours, resulted in a recovery of 2,700 ft. of oil and gas-cut mud, with no evidence of formation water. The lower sand is soft and porous, and showed saturation. At the start of cleaning-out operations the top-hole pressure was 635 psi., and bottom-hole pressure 2,100 psi. After being shut in 12 hours top-hole pressure had increased to 2,000 psi. When opened up it began flowing about ½ bbl. of 57°-gravity distillate per hour with some gas and considerable quantities of mud. On further testing the well flow increased to 3 bbl. per hour of distillate, with an estimated flow of 8,000,000 cu. ft. of gas per day, and a small decrease of drilling mud. On the last test reported, the gas had leveled off to 2,000 psi. at the top of the hole, but the flow of distillate and gas continued to increase. Cable tools are being moved in to continue testing and cleaning out and possibly to drill deeper. The sand is estimated to be around 300 ft. thick. So far, no evidence of formation water has been reported in any of the three sands.

South Baggs wildcat.—Kerr-McGee Oil Industries, Inc.-Phillips Petroleum Co. 1 Unit, SE SE 10-12n-92w, South Baggs district, Carbon County, Wyoming, just north of the Colorado line, is plugging back from 9,512 ft., and testing shows encountered in Wasatch sands. Casing was perforated progressively from 3,640 to 3,427 ft. Best showing was at 3,449-60 ft. where 3,000,000 cu. ft. of gas and 100 bbl. of water per day were encountered. These perforations will be squeezed off for further testing up the hole.

Steamboat Butte extension.—Brinkerhoff Drilling Co.-Sohio Petroleum Co. 1 Tribal, NW NW NW 9-3n-1w, a mile extension southeast in the Steamboat Butte field, Fremont County, Wyoming, on drill-stem test at 6,826-57 ft., in the top of the Tensleep, open 1 hour, recovered 2,900 ft. of oil. Total depth was 6,857 ft. Previous tests indicated commercial production in the Dakota and Nugget sands and a good show of oil in the Embar.

Douglas Creek development.—Further development of Douglas Creek gas field 25 miles southeast of Rangely, a discovery in 1943, will depend upon the outcome of negotiations. Superior Oil Co., joint operator with Continental and Union Oil companies in drilling the discovery, has pending before the Colorado Industrial Commission an application for a permit to build an 8-in. line from the field to Grand Junc-

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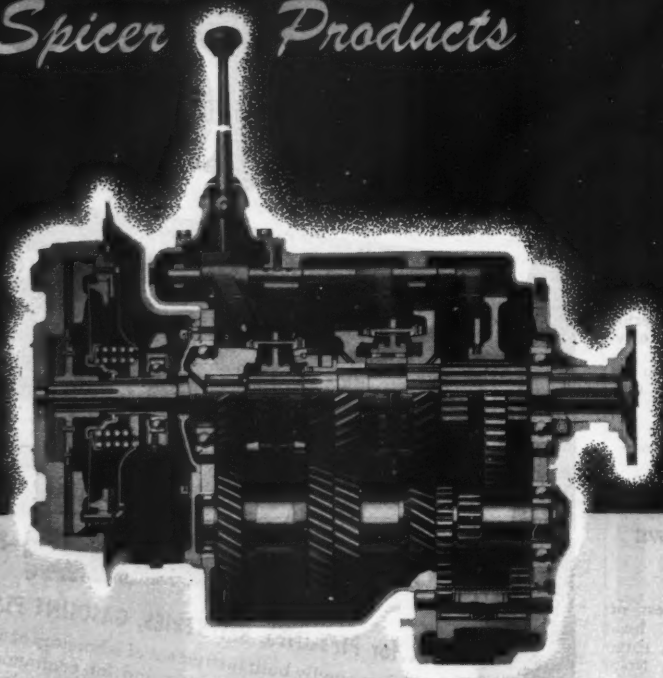

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PARISH FRAMES - STAMPINGS

tion, 60 miles to the south. Public Service Co. of Colorado, which manufactures and distributes gas in Grand Junction, has indicated its readiness to sign a contract for the purchase of the Douglas Creek gas, if the operators develop sufficient reserves to warrant a long-time contract. While the Continental and Union companies are joint owners with Superior in the development and operation of the field, the pipe line is an independent project of Superior.

Rangely outpost.—Stanolind Oil & Gas Co. 1 Pepper, SW SE NW 31-2n-101w, 1½ miles from nearest producer on east side of Rangely field, is showing for a producer in the upper part of the Weber sand. It had the Weber at 6,075 ft., and at a total depth of 6,377 ft., showed salt water. It was plugged back to 6,299 ft., and sand was shot with 242 qt. at 6,160-6,284 ft., after which it flowed 60 bbl. of oil in 12 hours. It is still cleaning out and swabbing.

New operations.—Eleven new operations were reported, of which seven were development wells and four were wildcats. The locations in Colorado included one in the Rangely field, and one in the Chromo district in Archuleta County. Wyoming had seven new operations, of which three were wildcats and the others, one each in Sulphur Creek, Uinta County, Hamilton, and Frannie fields. Montana had one wildcat and one development well in Cut Bank. The Chromo location is 2 Fitzhugh, SE NE NE 4-32n-1e, a southeast offset to the discovery well reported last month which made 210 bbl. in 18 hours at 471 ft., total depth.

One of the most interesting Wyoming wildcats is Sinclair-Wyoming Oil Co. 1 Unit, NE NE NE 27-39n-114w, on the Granite Creek structure, Teton County, at the north end of the Green River basin, and 60 miles south of Yellowstone National Park. It will be the first well drilled in the county in the general area of the Jackson Hole country. The unit, which was approved more than a year ago, contains 8,800 acres, and the test is scheduled to go to at least 4,500 ft. A tentative location for a 3,000-ft. test to the G-P sand is Union Oil Co. of California No. 1, NE SE SE 22-20n-84w, North Overland Dome, Carbon County, Wyoming, 2 miles west of a well drilled by General Petroleum in 1936 which went to the Sundance at a total depth of 6,482 ft., which had a good show of oil in the G-P sand. Another wildcat, in an area which has had little exploration, is Sinclair-Wyoming Oil Co. 1 Unit, SW NE NW 24-27n-101w, Oregon Trail structure, Fremont County, Wyoming, 48 miles west and a little south of the Crook's Gap field, and 35 miles south of Lander. The unit contains 15,200 acres. The estimated depth to the Frontier is 7,000 ft.

In Montana, Sinclair-Wyoming Oil Co. 1 H. G. Wilkins, NW SW NW 28-9s-23e, Elk Basin field, Carbon County, a wildcat 1 mile to the northwest of the nearest Tensleep sand well, is drilling.

Completions.—Eleven wells were completed, of which six were oil wells with initial production of 1,079 bbl., three were gas wells and two were dry holes. Three wells were completed in Rangely field in Colorado, of which two were oil wells for 262 bbl., and one a dry hole, an outpost on the west side in Continental Oil Co. 3 Rooth. Wyoming had five completions, of which three were oil wells for 697 bbl. initial, one was a gas well and one a wildcat, was a dry hole. Montana had two gas wells, one in the Bowdoin field and the other in Cut Bank. One well in the Aztec-Bloomfield district, San Juan County, New Mexico, made 2,900,000 cu. ft. of gas and 5 bbl. of oil per hour at 1,390 ft.

WYOMING WILDCAT FAILURE

Lysite, Fremont County: Sinclair-Wyoming 1 Lysite unit, NE NE NW 35-39n-91w, TD 12,500 ft., Mesa Verde 10,442 ft. Last test through perf. at 10,298-10,313 ft. flowed 24 bbl. of water per hour and 408,000 cu. ft. of gas per day, plugged.

V CANADIAN FIELDS

Canada's 1946 Production Totals 7,612,520 Bbl.

CHATHAM.—Output of crude petroleum from all Canadian fields in 1946 totaled 7,612,520 bbl. compared with 8,482,796 bbl. in 1945, according to official figures just made public. Turner Valley, still the most important producing field, showed a decline of more than 1,000,000 bbl. in limestone oil, from 6,980,838 to 5,902,877 bbl. Production from gas wells on separators was up from 24,751 to 25,597 bbl., and absorption plants increased from 412,540 to 434,210 bbl. while shallow crude increased from 3,932 to 8,888 bbl.

Offsetting the Turner Valley decline to some extent, the other Alberta fields were up from 557,725 to 766,960 bbl. Conrad,

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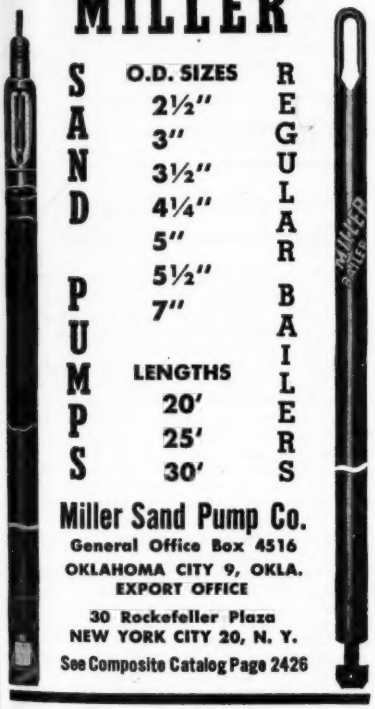

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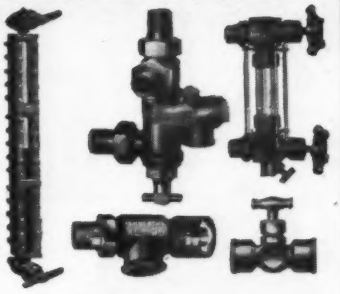

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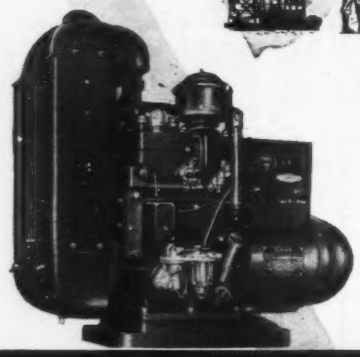

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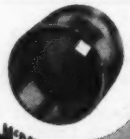

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Taber, Steveville-Princess, Lloydminster, and Vermilion were the major producing areas in 1946.

The Fort Norman field declined from 345,171 to 187,029 bbl., largely owing to the lack of the former export demand. Saskatchewan, as a result of intensive development in Lloydminster field, was up from 14,374 to 136,346 bbl. Ontario fields increased their output from 113,325 to 122,032 bbl., while New Brunswick declined slightly from 30,140 to 28,581 bbl.

Lloydminster.—In the Alberta end of Lloydminster field, Lyons 1, LSD 15, 11-50-2w4, finished at 2,012 ft., has set casing for a production test. On the Saskatchewan side, Lyons 3, SE 35-48-28w3, has been abandoned after getting lower Cretaceous at 1,742 ft. and Paleozoic limestone at 2,268 ft In the northern extension in Alberta, Commoil Lloyd 4, LSD 11, 10-50-1w4, is coring below 1,990 ft.

Leduc.—In Leduc field, southwest of Edmonton, Imperial-Leduc 1, LSD 5, 22-50-26w4, finished at 5,066 ft., has been placed on production but initial figure has not yet been announced. Imperial-Leduc 2, LSD 5, 22-50-26w4, is below 4,000 ft. Imperial-Leduc 3, LSD 10, 26-50-26w4, is rigging.

Del Bonita.—In the Del Bonita area, southern Alberta, McLeod-Del Bonita 1, LSD 13, 14-21-1w4, is waiting for better weather to drill out plug for a test of the Madison limestone. A number of tests drilled in the general area in recent years have encountered near-commercial shows of light crude in the top of the Madison, and the field at various times has shipped small quantities of crude.

ILLINOIS

New Producing Horizon In East Browns Outpost

MATTOON.—C. E. Skiles 5 Helm, NW NE NW 15-3s-14w, Wabash County, has pipe set at 2,635 ft. to test saturated sand found in the Paint Creek at 2,642-62 ft. A drill-stem test recovered 160 ft. of oil-cut mud and no water. This test, which was drilled to 2,748 ft., is an outpost well of the East Browns pool and other wells in this area produce from deeper depths in Benoist, Cypress, Waltersburg, or McClosky.

One mile northeast of the Lancaster pool, Arvin Drilling Co. have completed a 150-bbl. pumper in their No. 1 Alka, SW SW NE 35-2n-13w, Wabash County. The well was drilled to 2,750 ft. and plugged back to 2,677 ft. Production is from the Rosiclare found at 2,662-67 ft.

Nu-Enamel Corp. & Gilliam-Aspin 1 Adams, SW NW SE 10-6n-7e, Effingham County, located 2 miles north of the nearest production in the Bible Grove pool, has been completed as a 70 bbl. pumper in the McClosky at 2,868-78 ft. The well was treated with 6,000 gal. of acid.

K. M. Boyer et al. have started a wildcat operation about 7 miles southwest of the Locust Grove pool in their No. 1 Page, SE SE NE 34-8s-4e, Williamson County. First reports have been made on 4 other wildcats in Illinois for the current week, 1 each in Effingham, Edwards, Fayette, and Jasper counties. There were 28 first reports on field wells.

ILLINOIS SUCCESSFUL WILDCAT

Wabash County: Arvin Drilling Co. 1 E. Alka, SW SW NE 35-2n-13w, pumped 150 bbl., Ste. Genevieve 2,641 ft., Rosiclare 2,662 ft., McClosky 2,684 ft., Perf. 2,661-68 ft., 1,500 gal. acid, TD 2,750 ft., PB 2,677 ft.

ILLINOIS WILDCAT FAILURES

Cumberland County: Texas Co. 1 Gibbons, SW SW NW 35-9n-7e, dry at 2,613 ft., Tar Springs 1,944 ft., Cypress 2,274 ft., Ste. Genevieve 2,451 ft., McClosky 2,497 ft.

Wayne County: O. C. Borah 1 Jones, NW

SW SE 11-1n-5e, dry at 3,082 ft., Tar Springs 2,288 ft., Glenn Dean 2,390 ft., Barlow 2,562 ft., Cypress 2,594 ft., Benoist 2,802 ft., Ste. Genevieve 2,929 ft., and St. Louis 3,072 ft.

OHIO, KENTUCKY

Clinton Sand Test Shows for Good Oil Well

COLUMBUS.—The Clinton sand in Salt Creek Township, Muskingum County, which usually is either dry or produces gas, showed both oil and gas in the No. 1 O. C. Robinson, Section 15, drilled by B. G. Bartley. The well was drilled on down to the Medina sand where another show of oil was found. After shooting both sands the well flowed 93 bbl. and swabbed 30 bbl. in 40 hours. Top of the Clinton at 4,086 ft. started to show oil at 4,135 ft.

The second gas well in the new pool near Elyria in Carlisle Township, Lorain County, had 485,000 cu. ft., natural, and after shot gaged 850,000 cu. ft. The well was completed by B. G. Harmon et al on Tony Polen, Section 3, with the Clinton sand at 2,294-2,305 ft.

An east extension to La Grange pool was brought in by Ohio Fuel on Lottie Burton, Lot 73, La Grange Township, Lorain County. The Clinton sand at 2,452-60 ft. gaged 1,470,000 cu. ft. natural. The company will move ⅓ mile northeast for the offset.

Eight locations were reported in Stark County with all except one in Canton. Three locations were reported in Monroe County, two in Muskingum County, and seven scattered. Ashland field led in completions with 7 out of 25.

OHIO WILDCAT FAILURE

Cuyahoga County, Olmsted Township: Ohio Fuel Gas 1 S. W. Jennings, Lot 3, Clinton 2,632-42 ft., TD 2,747 ft.

EASTERN KENTUCKY

ASHLAND.—The report for the week in eastern Kentucky listed one completion, dry. Kentucky-West Virginia Gas Co. completed well 5,699 on the W. J. Ward property, Martin County, at 2,429 ft.

New locations were listed on the property of Joseph Stewart, 5,731, Knott County; William Hyden, 4,726, Johnson County; Grant Green 854, and Sallie Howard 856, Magoffin County, and Thomas Terry, Knott County, 857.

KENTUCKY

OWENSBORO.—R. T. Holtzclaw 1 Cavender, 9-M-29, McLean County, located about one mile northwest of the Barrett pool, has been completed as a 25-bbl. pumper in Pennsylvanian sand at 1,147-61 ft. after a 30-qt. shot. Total depth is 1,161 ft.

Kentucky reported five field completions for the past week, three producers and two dry holes. In the Tunnell Hill pool, Carter Oil 1 Duncan, NE NE SW 4-N-23, Henderson County, swabbed 313 bbl. of oil per day, free of water, from the Waltersburg at 1,797-1,823 ft. and the Cypress at 2,276-89 ft.

WESTERN KENTUCKY SUCCESSFUL WILDCAT

McLean County: R. T. Holtzclaw et al. 1 Cavender, 9-M-29, pumped 25 bbl., shot 39 qt., Pennsylvanian sand 1,147-61 ft., TD 1,161 ft.

INDIANA

EVANSVILLE.—John A. Savage 1 Hall, SW SW SE 19-1s-10w, Gibson County, located 1 mile northeast of the nearest production, which is in the Princeton pool, is testing the Cypress sand at 1,665-75 ft., total depth 1,919 ft. After shooting with 40 qt., the test swabbed 60 bbl. of oil per day. The McClosky at 1,911-15 ft. has not been tested. One location to the north the same operator's No. 2 Hall is testing saturation in the Lower Cypress found at 1,722-42 ft.

OKLAHOMA

Garvin County Discovery Flows 20 Bbl. Oil Hourly

A. R. McELREATH et al. 1 Barnett, NW NE SW 24-3n-1w, about 2 miles southwest of Pauls Valley, flowed 20 bbl. oil per hour on drill-stem test, and appears to be the fifteenth new pool discovery in western Garvin County. Pennsylvanian was logged at 4,043 ft. and Simpson at 4,050 ft. A drill-stem test at 4,043-50 ft. recovered an estimated gas volume of 5,000,000 cu. ft. per day. After deepening to 4,057 ft., a second drill-stem test was made at 4,050-57 ft. which recovered 2,500,000 cu. ft. of gas per day and 20 bbl. of oil per hour. Casing is being set at 4,054 ft. to shut off the gas zone.

Garvin County's new discovery, Anderson & Prichard Oil Corp. and Stephens Petroleum Co. 1 Seaton, SE SE NW 14-2s-2w, which last week flowed 50 to 100 bbl. of 42°-gravity oil per hour on drill-stem test in Pennsylvanian sand at 6,408-43 ft., is testing after setting 7-in. at 6,500 ft. Pipe was perforated opposite the Gibson sand at 6,424-54 ft. On a 4-hour test through ½-in. choke, the well flowed from 33.75 to 48.5 bbl. of cut fluid, with oil content steadily increasing. Choke was opened to ⅝ in. and the well flowed 60.5 bbl. the fifth hour and 71.5 bbl. the sixth hour. Fluid was 90 per cent oil at the end of the test.

Southwest Antioch appears to be getting its first Bromide production in Globe Oil & Refining and Vickers Petroleum Co. 1 Carr, NW NE SE 29-3n-2w, Garvin County, located on the east side of the pool. A drill-stem test at 7,275-93 ft., open 1 hour, recovered 2,100 ft. of 42°-gravity oil and 450 ft. of water. Casing is being set to test.

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Ohio Oil Co. 1 Woods, NE SW NE 17-3n-5w, Grady County, on the west flank of the Knox pool, appears to be giving that area a new productive zone. A drill-stem test, at 3,480-3,509 ft. in the Dornick Hills sand, recovered 1,320 ft. of 41.7°-gravity oil and 300 ft. of oil and gas-cut mud.

The Southeast Meno gas-distillate discovery well, R. Olsen 1 Ott, SW SE 4-21n-9w, Major County, which flowed distillate and brackish water when connected to pipe line, is reported not to be making formation water. On a full day's test, the well flowed 2,000,000 cu. ft. gas, 44 bbl. of distillate and 7 bbl. of water and mud-conditioning material. Water analysis shows the water is not from the Wilcox pay formation.

OKLAHOMA WILDCAT FAILURES

Carter County: Amerada Petroleum Co. 1 Margo, SE SE SW 17-4s-3w, dry, TD 3,555 ft., no tops reported.

Cotton County: Bridwell Oil 1 Roberts, NW NW SE 8-1s-9w, dry, TD 3,400 ft., lime 1,852-79 ft., 1,999-2,004 ft. and 2,124-29 ft., sand 2,306-08 ft. with a show of oil.

R. G. Anderson 1-A Stoner, NW NE SE 13-2s-13w, dry, TD 853 ft., no tops reported.

M. W. Blair 1 Derdenhoeffer, NE NE SW 3-3s-13w, dry, TD 2,365 ft., Granite Wash 1,407-1,643 ft.

Kingwood 1 Sellers, SW NW NW 27-3s-11w, dry, TD 2,510 ft., sand 1,560-63 ft. with a show of oil and 1,566-77 ft. with a show of oil and water, Megargle lime 1,949-60 ft.

E. P. Griffin 1 Scruggs, SE SE NW 21-4s-11w, dry, TD 1,820 ft.; sand 1,230-55 ft., with a show of oil.

Garvin County: Bishop Oil 1 McConnell, NE NE NW 14-3n-3e, dry, TD 2,095 ft., sand 1,249-71 ft. and 2,062-95 ft.

Hughes County: Texola Drilling Co. 1 Bartlett, SW SW SE 13-7n-9e, dry, TD 3,110 ft., Calvin 760 ft., Henryetta coal 910 ft., Senora sand 1,000 ft., Senora lime 1,050 ft., brown lime 2,932 ft., Booch 2,938-70 ft., Lower Booch 3,004-14 ft.

Jefferson County: Henry Zeweifel 1 Wright, SE SE SW 34-4s-8w, dry, TD 2,000 ft., no tops reported.

Kiowa County: Hartwell et al 1 Williams, SE SE NW 13-1n-17w, dry, TD 620 ft., no tops reported.

Pottawatomie County: T. N. Berry 1 Andes, NW NW SE 15-6n-3e, dry, TD 3,020 ft., Pawhuska 1,660 ft., Belle City 2,645 ft., Hogshooter 2,908 ft., Layton 2,985 ft.

Seminole County: Davon Oil Co. 1 Reed, SW SW NE 33-9n-7e, dry, TD 3,480 ft., Calvin 2,230 ft., Earlsboro 2,882 ft., brown lime 3,188 ft., Booch 3,325-45 ft., Gilcrease 3,380-82 ft., Wapanucka, 3,397-3,402 ft., Cromwell 3,402-38 ft., shale streaks 3,850 ft., sand 3,450-62 ft.

Tillman County: M. A. Freeman 1 Wells, SE SE NE 9-1s-17w, dry, TD 2,920 ft., no tops reported.

LA.-ARK.

McAlester Fuel 1 Patterson To Test James Limestone

SHREVEPORT.—In Union County, Arkansas, McAlester Fuel Co. 1-A J. H. Patterson, SE SW 19-18s-14w, squeezed all perforations and made new holes at 3,538-46 ft., in the Travis Peak. In a drill-stem test, with ¼-in. chokes, fluid rose to within 30 ft. of the top. It was swabbed for 10 hours but recovered only salt water with a slight show of gas. Operators were to plug back and test the James limestone at 3,000 ft. Location is 2½ miles south of Nacatoch production in Woodley field.

E. A. Gabriel et al 1 Martindale, NW NW 32-14s-28w, Miller County, 6 miles north of Texarkana, was drilling below 5,217 ft. in Travis Peak. Cores at 5,130-33 ft. recovered broken sand with no shows, and at 5,211-16 ft. the recovery was 3 ft. of hard sand, with no shows.

In Bienville Parish, Lion Chemical Corp. 1 Ozley, SW NE 13-17n-6w, set casing at 7,970 ft., after killing gas pressure, and was preparing to drill ahead below total depth of 10,732 ft. Barnsdall Oil Co. 1 D. Johnson, NE SW SE 30-23n-12w, Bossier Parish, plugged back from 7,510 ft. to 3,270 ft., set casing at 3,225 ft. and was waiting on cement before testing shows shown by side-wall cores in sand at 2,841-3,314 ft.

MISSISSIPPI

Testing Continued at Gulf Oil 1 Rowland

JACKSON.—Gulf Oil Corp. continued testing its 1 Rowland, Section 39-4n-2e, Amite County. Packer was reset at 11,336 ft., but it would not flow under a 6,000-ft. water cushion. Swab was run to 7,500 ft., the tool pulled and the recovery was 4,000 ft. of fluid, being 3,600 ft. of water cushion, 30 ft. of drilling mud, and 360 ft. of salt water. A bridge plug was set at 11,345 ft., casing perforated at 11,325-30 ft. and a drill-stem test made, with packer at 11,227 ft. The well was swabbed down to 8,200 ft., recovering water cushion. It was then let stand for 12 hours before swabbing, which recovered 1 bbl. of fresh water, 2 gal. of brown oil, testing 37.1° gravity, and

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SUMMARY OF FEBRUARY COMPLETIONS

	Comp.	Oil	Prod.	Gas	Dry	Under 1,000 ft.	1,000-2,500 ft.	2,500-5,000 ft.	5,000-10,000 ft.	Over 10,000 ft.	Total footage	Rigs and drilling
New York	82	41	111	0	[1]41	0	82	0	0	0	119,000	108
Pennsylvania	208	99	198	17	[2]92	0	186	22	0	0	339,755	170
West Virginia	74	4	77	56	14	1	33	32	8	0	220,425	195
Ohio	79	15	457	41	[3]23	3	24	52	0	0	252,079	216
Indiana	35	18	1,410	6	11	9	23	3	0	0	61,155	71
Kentucky	28	5	578	12	11	3	12	13	0	0	62,146	51
Illinois	132	80	7,360	0	52	3	47	82	0	0	334,428	229
Michigan	24	10	762	1	13	1	11	12	0	0	55,858	94
Kansas	198	93	38,357	42	[4]63	0	10	186	2	0	652,266	272
Neb., Mo., Iowa	1	0	0	0	1	0	1	0	0	0	1,180	13
Oklahoma	325	173	27.034	17	135	19	121	127	55	3	1,031,028	512
Texas	648	394	81,965	50	204	36	145	242	212	13	2,976,342	865
North	140	82	7,120	1	57	13	61	38	28	0	423,012	166
West Central	67	26	3,467	3	38	2	16	46	3	0	221,720	54
West	153	128	52,731	2	23	4	34	50	59	6	788,745	135
Panhandle	36	20	3,190	13	3	1	2	31	2	0	119,227	119
Eastern	42	15	2,196	6	21	2	2	16	22	0	219,970	81
Gulf Coast	99	[5]61	6,192	11	27	0	1	15	78	5	657,977	236
Southwest	111	[6]62	7,069	14	35	14	29	46	20	2	545,691	74
Louisiana	92	60	8,036	8	24	7	18	27	27	13	512,849	171
Northern	52	[7]28	2,256	8	16	7	15	20	9	1	172,263	58
Southern	40	[8]32	5,780	0	8	0	3	7	18	12	340,586	113
Arkansas	17	11	1,065	1	5	0	1	12	4	0	71,586	29
Mississippi	20	[9]15	7,846	0	5	0	1	2	7	10	176,728	96
Ala., Ga., Fla.	6	1	50	0	5	0	1	3	2	0	22,419	18
Montana	13	1	59	10	2	0	10	3	0	0	21,697	36
Wyoming	16	8	1,733	3	5	0	1	8	4	3	94,068	65
Colorado-Utah	8	6	1,396	0	2	1	0	1	6	0	42,026	64
New Mexico	43	31	7,923	6	6	0	5	16	22	0	211,014	115
California	150	118	19,420	3	29	0	47	65	36	2	661,677	230
Total February	2,199	1,183	205,837	273	743	83	779	908	385	44	7,919,726	3,620
Total January	2,742	1,502	250,131	286	954	116	936	1,151	470	69	9,777,350	3,760

Service wells: (1) 41, (2) 86, (3) 1, (4) 3. Distillate wells: (5) 9, (6) 3, (7) 1, (8) 7, (9) 2.

a small amount of gas. Operators continued to swab.

In Wayne County, Humble Oil & Refining Co. 2-B G. M. & O. Land Co., 24-9n-8w, drilled out to 9,626 ft., perforated at 9,620-24 ft., and with packer set at 9,583 ft. ran a drill-stem test. In 75 minutes the recovery was 360 ft. of oil-stained mud, with a slight show of gas, with no salt water. Operators were to reperforate and test further.

FLORIDA WILDCAT FAILURE

Gadsden County: Havana Syndicate, Inc., 1 A. M. Butler, SE SW 30-3n-1w, dry, TD 4,010 ft., no tops reported.

KANSAS

Pipe Set on Three Promising Wildcats

FIVE miles northeast of the Webster pool, Rooks County, Phil-Han Oil Co. and Bird & Boreing 1 Veverka, SE SE SE 7-8s-18w, is setting pipe on top of the Arbuckle topped at 3,405 ft. after drill-stem test at 3,405-13 ft. recovered 30 ft. of oil and 95 ft. of oil-cut mud.

One mile east of the Cotton pool in Trego County, Continental Oil Co. 1 Cotton, a stratigraphic test in SE SE NW 14-12s-21w, had top of Arbuckle at 3,949 ft. A drill-stem test at 3,949-92 ft. recovered 120 ft. of oil in 60 minutes. Pipe was set at 3,950 ft.

Huber & Wakefield 1 Ficken, NW NW NE 32-19s-18w, Rush County, 13 miles west of West Ryan pool, had a show of ½ bbl. of oil per hour when plug was drilled out and is testing.

The Northwest Burnett pool on the Rooks-Ellis county line has been extended nearly ½ mile southeast by Midstates Oil Corp. 1 Cross, NW NE SW 2-11s-18w, Ellis County. Drilled to 3,535 ft., pipe was set on top of the Arbuckle at 3,526 ft. When the cement was drilled out the hole filled 2,730 ft. with oil in 1 hour.

Bay Petroleum and H. H. & B. Drilling Co. 1 Wise, NE NE NE 1-21s-16w, Pawnee County, located ½ mile west and ¼ mile west of the same operators' No. 1 Wise which opened Ash Creek pool with a 477-bbl. Arbuckle well, has found the Arbuckle 10 ft. higher than in the discovery well. A drill-stem test in the Arbuckle had spray of oil in 18 minutes and 250 ft. of oil and gas spraying oil in 20 minutes.

Bennett & Roberts 1 Dobrinski, NW NW NE 16-17s-9w, Ellsworth County, is a 50-bbl. well in the Lansing from perforations at 2,977-81 ft. The test was drilled 10 ft. into the Simpson to 3,310 ft. and plugged back to 2,980 ft. to test the Lansing which was topped at 2,906 ft.

KANSAS SUCCESSFUL WILDCATS

Barton County: Bay Petroleum and H. H. & B. Drilling 1 Houdyshell, NE SE SW 31-20s-15w, pumped 447 bbl. 38°-gravity oil per day from Arbuckle at 3,834-50 ft.; anhydrite 1,010 ft., Lansing-Kansas City 3,442 ft., conglomerate 3,708 ft., Simpson 3,757 ft., TD 3,850 ft.

Ellsworth County: Bennett & Roberts 1 Dabrinski, NW NW NE 16-17s-9w, pumped 50 bbl. oil per day from Lansing-Kansas City at 2,977-81 ft.; Topeka 2,508 ft., Heebner 2,766 ft., brown lime 2,883 ft., conglomerate 3,230 ft., Simpson 3,300 ft., TD 3,310 ft.

KANSAS WILDCAT FAILURES

Barber County: H. W. Skinner 1 fee, NE SW NE 5-32s-11w, dry, TD 4,406 ft., Lansing-Kansas City 3,750 ft., Mississippi lime 4,337 ft.

Pawnee County: Berwick Spruill & Harms 1 Tammen, NE NE NE 9-20s-16w, dry, TD 3,817 ft., anhydrite 1,055 ft., Lansing-Kansas City 3,415 ft., conglomerate 3,709 ft., Arbuckle 3,752 ft.

Sumner County: Wakefield & Flynn 1 Frantz, NE NE SE 8-31s-3w, dry, TD 4,522 ft., Lansing-Kansas City 3,335 ft., Mississippian 3,969 ft., Basal Mississippian 4,310 ft., Simpson 4,382 ft., Arbuckle 4,492 ft.

LEGAL

UNITED STATES DEPARTMENT OF AGRICULTURE, Farmers Home Administration, Dallas, Texas. Sealed bids in duplicate will be received until 3:00 P.M. (CST) April 15, 1947, and then publicly opened, offering bonus for operating rights in connection with gas and oil leases on 2207 acres of land, more or less, located at Wichita Valley Farms, Wichita County, Texas. Award of lease will be made only to bidder who can show sufficient experience and financial resources and prove citizenship. Interested parties may obtain bid documents, lease forms and operating regulations from Regional Chief, Administrative Service Division, Farmers Home Administration, 2001 McKinney Avenue, Dallas, Texas.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Washington 25, D. C. Notice is hereby given that sealed bids will be received until 1 P.M., Wednesday April 2, 1947, for SW¼SW¼ sec. 22, T. 11 N., R. 20 W., S.B.M., 80 acres, situated within the known geologic structure of the Wheeler Ridge field, California. This land is offered to qualified bidders of the highest cash amount per acre as a bonus for the privilege of leasing the land under section 17 of the leasing act of February 25, 1920 (41 Stat. 437), 30 U.S.C. sec. 181) as amended. Royalties payable to the United States will be at the rate of 12½ per cent to 25 per cent for oil, and 12½ per cent to 16 2/3 per cent for gas, in accordance with Schedule B in the lease form. Each bidder must submit with the bid one-fifth of the amount bid in cash, or by certified check on a solvent bank, or by money order, made payable to the order of the Treasurer of the United States, and file the showing of qualifications to receive a lease, required under 43 CFR 192.42(b) and (c). The envelopes should be plainly marked, "Bid for lease, Wheeler Ridge field, California. Not to be opened before 1 P.M., April 2, 1947." No bids received after the hour fixed herein for submitting bids will be considered. The remainder of the bonus and the annual rental at the rate of $1 per acre must be paid and a corporate surety bond in the sum of at least double the amount of rental, but in no case less than $1000 nor more than $5000 must be furnished by a successful bidder prior to the issuance of a lease. The deposits of the other bidders will be returned upon acceptance of the successful bids. The successful bidder will be required to agree not to discriminate against any employee or applicant for employment because of race, creed, color, or national origin, and to require an identical provision to be included in all subcontracts. Bidders are warned against violation of section 59, U. S. Criminal Code, approved March 4, 1909, prohibiting unlawful combination or intimidation of bidders. The right is reserved to reject any and all bids. Fred W. Johnson, Director.

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Among the Drilling Contractors

Meredith, Clegg & Hunt, Houston, have set 10¾-in. surface pipe at 1,840 ft. on Sohio Petroleum Co. 1 Calcasieu National Bank, Calcasieu Parish, Louisiana. Contract depth 10,900 ft. This test is in the newly opened Holmwood pool.

C. W. Kendall has been awarded drilling contract on the James M. Burton 1 Howard Haight, in NW NW SE 26-2n-13w, Allegan, Michigan.

Sam L. Tennant Drilling Co., Blackwell, Okla., is drilling at 1,800 ft. at the Hensel farm, in SW 17-27n-2e, Kay County, Oklahoma, for Oklahoma Exploration Co. This is a Bartlesville test.

Guy Mabee Drilling Co. has started drilling at its 5,000-ft. rotary wildcat, the 1 W. L. Ellwood estate, in the Wichita County School Land Survey, 9 miles east of the north end of the Slaughter field, Hockley County, West Texas.

Zack Brooks is drilling contractor on the Atlantic Refining Co. 1 Dunning, wildcat in Section 12-19n-16e, Clay County, Mississippi. Location is 6 miles southeast of West Point. Drilling has resumed after a shutdown, and hole was below 4,330 ft.

L. T. Barber is the drilling contractor on the Michigan Consolidated Gas Co. 1 A. J. Brandt and R. V. Keck, in C SW¼ 29-13n-6w, Isabella County, Michigan.

Owen Rives is drilling contractor on the C. E. Skiles and C. C. Nye 1 well, in SW SW SW 19-9n-7e, Seminole County, Oklahoma, which was spudding.

Moran Drilling Co. has drilling contract on the Carter Oil Co. 1 Gentry, in Section 24-O-23, Henderson County, Kentucky.

George P. Livermore is drilling contractor on the DeKalb Agricultural Association 1 J. M. White and G. M. Sheldon, which has been staked 660 ft. from north and east lines of Section 404, Block G, CCSD&RGNG Survey, Gaines County, Texas. Contractor was moving in materials for the 7,500-ft. test, 12 miles west of Seminole and 5 miles northwest of Cities Service Oil Co. 1 Riley, prospective Clear Fork discovery.

Dan Rives is drilling contractor on the Ray Hudson 1 Bartlett, in NW NE NW 18-7n-10e, Hughes County, Oklahoma, which was drilling below 1,120 ft. on extension try east of the Grief Creek area.

Wallace Bogart, Lubbock, Tex., was reported to have received contract, plus an interest in the test, for Shamrock Oil & Gas Co.'s Hale County, Texas, wildcat. Location for the test is in the Cotton Center area of southwest part of the county, and about 7 miles north of the Irish field.

Big Chief Drilling Co. has staked location for its 1 Sayre, in SE NW NE 15-16n-7e, Richland Parish, Louisiana. This wildcat location is on a Carter Oil Co. farmout, with support from Stanolind Oil & Gas Co. and Sohio Petroleum Corp.

Mealy-Wolfe Drilling Co. has drilling contract on the W. D. Shelton and associates 1 N. J. Phillips, in SE NE NE 8-9n-6e, Hughes County, Oklahoma. Derrick was building and rotary tools were being moved in for the test, where Wilcox sand production will be sought.

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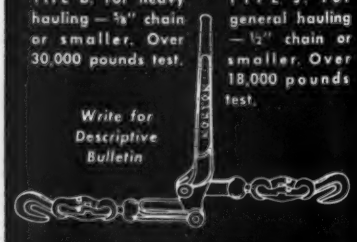

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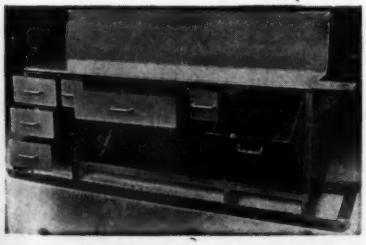

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HOUSTON TEXAS

R-H-K Drilling Co., Ltd., has started its 1 R. H. Collins estate, a 4,700-ft. rotary test in Lot 34, League 150, DeWitt County School Lands Survey, Jones County, West Central Texas. This test is an offset to the county's only Strawn production.

Davenport Drilling Co. was moving in to start its 2 Hinton, in SW NW NE 10-7n-17w, in the Northeast Hobart field, Kiowa County, Oklahoma.

Harry Porter Drilling Co. is contractor on the Windsor Oil Co. 1 Burford, which was moving in for test in the Kickapoo field, of De Soto Parish, Louisiana. Location is in SW SE 8-14n-14w.

Mealy-Wolfe Drilling Co. was expecting to start its 2 Wallace, in SW NW NE 7-8n-7e, Seminole County, Oklahoma.

Perry-Busk & Ormiston are drilling contractors on the Clifford A. Perry 1 John Arens, in SE NW NW 26-6n-15w, Ottawa County, Michigan.

Roxie Wright is drilling contractor on a Wilcox zone wildcat test in San Jacinto County, Texas, being drilled by the cinema actor Phil Harris and actress Alice Faye.

Pat Drilling Co., of Duncan, Okla., has been organized by James L. Patterson, Everett G. King, and Carl Jones, all of Duncan. Capital stock is reported as $50,000.

Virginia Drilling Co. has operations under way at its 1 Grow, in SE SE NW 14-21-12, ½ mile northeast of the Saundra pool in Stafford County, Kansas. The firm recently completed a dry hole ½ mile due east of the pool at its 1 Thul, in NW NW NE 23-21-12.

Justrite Drilling Co. was starting its 1 Brecco, in NE SW SW 29-7n-6e, Seminole County, Oklahoma, for a 3,500-ft. test.

Kingery Brothers had the drilling contract on the A. R. McElreath et al 1 Barnett, in NW NE SW 24-3n-1w, Garvin County, Oklahoma. On drill-stem test this wildcat showed an estimated 5 million cubic feet of gas per day, at 4,043-50 ft. Deepened to 4,057 ft. a second drill-stem test was made to recover a flow of 20 bbl. of oil an hour.

Exploration Drilling Co., Tulsa, has two wildcat tests scheduled for western Jones County, Texas. These are the Exploration and Western Oil Development Co. 1 G. C. Maynard, and the Exploration 1 Guy E. Gabbart. First of these will be a 4,200-ft. rotary test 8 miles southeast of Hamlin, and the second is a 4,500-ft. rotary test 4 miles southeast of McCaulley.

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PERSONALS

Sun Manufacturing Head Began as Office Boy

CLARENCE H. THAYER, 49, Sun Oil Co. vice president in charge of manufacturing, entered the oil business 33 years ago as an office boy in the Richmond refinery of Standard Oil Co. of California.

Twelve years later, in 1926, he resigned as assistant superintendent of maintenance in the refinery to join Sun as an engineer in the Marcus Hook, Pa., refinery. In the Standard of California organization, Thayer had been promoted to draftsman, chief draftsman, and project engineer before being named assistant maintenance superintendent. The 12-year period included 2 years with the Army Corps of Engineer, 18 months of which he spent in France.

With Sun he soon became assistant superintendent of pressure stills, then superintendent, and in 1933 was transferred to Philadelphia as assistant to Arthur E. Pew, Jr., then vice president in charge of manufacturing. A month later he was appointed chief engineer of the company.

In 1940 Thayer was cited for his work in the commercial development of the Houdry catalytic-cracking process, and in 1941 was elected to Sun's board of directors. He is the holder of several oil-process and equipment patents.

W. H. Farrand, assistant manager of The Texas Co.'s foreign producing department in New York, is visiting Bogota.

R. P. Russell, president of Standard Oil Development Co., returned recently from Venezuela where he gave a series of lectures.

A. A. Curtice and **Herbert Hoover, Jr.,** of Hoover, Curtice & Ruby, Inc., geologists and engineers, have been on an extended trip to Guatemala.

Halbert M. McClain, in charge of secondary-production operations for Magnolia Petroleum Co., Dallas, will address the Mid-Continent section of the American Society of Mining and Metallurgical Engineers on "Some Practical Aspects of Water-Flooding Operations" Monday evening, March 31, in Tulsa.

Joe Wheeler, district geologist at Jackson, Miss., for Stanolind Oil & Gas Co., has been transferred to Oklahoma City as district geologist. He has been succeeded in Jackson by **Alvin R. Winzler.**

E. L. Fry, field superintendent of Winona Oil Co., has retired after serving with the company 43 years. He joined the company in 1904 and has been field superintendent since 1914.

A. W. Cullen has been named district geologist in Denver for Lion Oil Refining Co. **C. E. Edmondson** has been placed in charge of the land department there. **T. H. Barton,** president, said the company is planning an extensive exploration program for western Colorado, eastern Utah, and northwestern New Mexico.

Niels C. Georgesen has resigned as district geologist for Tide Water Associated Oil Co. to enter the independent consulting field. His offices will be in the Hulman Building, Evansville, Ind.

Don T. Andrus, Bradford, Pa., independent producer, has been named chairman of a five-man commission within the Interstate Oil Compact Commission to study the problem of obtaining maximum recovery of oil from the nation's stripper-well reserves. Other members of the committee, announced by **Hiram M. Dow,** compact commission chairman, are **William J. Murray, Jr.,** member of the Texas Railroad Commission, vice chairman; **J. E. Berry,** Smackover, Ark., independent producer; **Ivan G. Burrell,** Ohio Oil Co., Bridgeport, Ill.; and **Charles B. Peters, Jr.,** Tulsa, independent producer.

Ralph Curtis, member of the firm of Earlougher Engineering, Inc., Tulsa, has resigned to become production manager for **C. H. Murphy, Jr.,** independent operator who has properties in South Arkansas and North Louisiana.

J. H. Wardlaw will be transferred May 1 from Socony-Vacuum Oil Co., S. A., in Venezuela, to head the producing operations in Spain of Compania Investigaciones Espanola de Petroleos Scientificas, S.A., of which Socony-Vacuum is part owner.

Elihu Madison has been named economist for The Texas Co. Madison joined Texaco in 1929 in the accounting office of the refining department at Houston and was transferred to the New York office in 1933.

A. R. Bowles, Salem, Ill., safety engineer for The Texas Co., has been awarded the president's medal of the National Safety Council for his aid in saving the lives of three persons overcome by gas in Lawrenceville, Ill., last May.

Harry H. Mack, vice president and manager of the California division of Sunray Oil Corp., has resigned. He expects to enter the oil business in Tulsa.

W. C. Hutchins, chief of materials section, Socony-Vacuum Oil Co., S.A., has been transferred to the same position for Socony-Vacuum in Cairo, Egypt.

John A. Bolt has been appointed assistant superintendent of technical service in the research department of Standard Oil Co. (Ind.) Bolt joined the company in 1930 as a chemist in the research laboratories at the Whiting refinery and since 1944 has been a group leader. Four group leaders have been appointed in Indiana Standard's research department. They are **David W. Bransky, D. E. Bruce, T. B. Tom, Lindsay M. Hobbs. John E. Swearingen,** group leader in the research department at Whiting, will be transferred April 1 to Stanolind Oil & Gas Co. at Tulsa; and will be succeeded by **Carl W. Peters.**

B. A. Hardey, Shreveport, president of the Independent Petroleum Association of America, will speak on "Economic Dividends from a Stable Petroleum Industry" April 3 at a luncheon meeting of the Tulsa Chamber of Commerce.

William F. Moore, the newly elected president of Arabian American Oil Co., is now in Dhahran, Saudi Arabia, on a business trip with **Fred A. Davies,** vice president, **J. C. Stirton,** chief engineer, and **Charles A. Johnson,** engineer.

George D. Champlin, formerly supervising engineer for Plantation Pipe Line Co., Atlanta, Ga., has become pipe-line research coordinator of Standard Oil Development Co., New York. He succeeds **J. C. Rawline,** who is being assigned to other work.

W. E. Bates, Houston, has been named representative of crude-oil purchasing and sales division for The Texas Co., with new offices at Midland, Tex.

Russell L. Furbee has announced his resignation as vice president of Gordon Oil Co., Mount Pleasant, Mich. He plans to operate as an independent.

W. J. Connelly, construction manager of Creole Petroleum Corp.'s projected Amuay Bay, Venezuela, refinery, is in the United States on a short business trip. Accompanying him is one of his assistants, **Dr. J. D. Long.**

Jack A. Lewis, Upper Gulf Coast examiner for the Federal Petroleum Board of the Department of the Interior, has joined Tennessee Gas & Transmission Co. as a petroleum engineer. **Dan W. McCauley,** former division geologist for British-American Oil Producing Co. at Houston, has joined the company as a geologist.

Dr. John R. Bates has been named assistant to the vice president in charge of manufacturing of Sun Oil Co. Both he and **R. W. Pack,** general manager of Sun's Gulf Coast division, were named to the company's board of directors in a recent board meeting in which **Joseph N. Pew, Jr.,** was elected chairman of the board and **Robert G. Dunlop,** president of the company. Dr. Bates joined Sun in 1942 after resigning as director of research for Catalytic Development Co., subsidiary of Houdry Process Corp. Pack joined the company as chief geologist in 1917 and was named to his present position in 1920. The board elected **Donald P. Jones,** comptroller, and named Jones, **Frank R. Markley,** general sales manager, and **William D. Mason,** director of industrial relations, to the directorate.

DR. J. R. BATES

R. W. PACK

David R. Williams and **Guy S. Connors,** vice presidents, Williams Brothers Corp., left by airline for England March 23, en route via Paris, Rome, Athens and Cairo to Arabia where they will look over the 450-mile section of the route of the Trans-Arabian crude-oil pipe line which their firm is preparing to construct.

New officers of the Illinois Oil and Gas Association were chosen at the association's recent meeting in Mount Vernon. They are, as shown above at the meeting: Second vice president, A. J. Rosenlieb, division manager, Ohio Oil Co., Marshall, Ill.; president, Walter Duncan, Jr., Walter Duncan Oil Properties, Mount Vernon; secretary, H. C. O. Clarke, division manager, Pure Oil Co., Olney, Ill.; first vice president, T. B. Steele, general superintendent, Kewanee Oil Co., Robinson, Ill.; and treasurer, Basil Moss, division land man, Magnolia Petroleum Co., Mount Vernon. (A report of the meeting appeared in The Oil and Gas Journal, March 22, page 133)

Clayton Wallace and **Elton Collins** have been transferred from Illinois to Stone Lake field, Michigan, as production foremen by Carter Oil Co.

John Johnston, geologist, has been transferred to Wichita, Kans., from Oklahoma City by Stanolind Oil & Gas Co.

Fred M. Manning, independent operator, will move his North Texas headquarters from Wichita Falls, Tex., to Fort Worth, effective April 1, according to **R. J. Dilger,** manager of the North Texas division.

Shifts

James D. Moore, Jr., chemist, Standard Oil Co. of California, Berkeley, Calif., to Bakersfield, Calif.; **Chester A. Davis,** engineer, Richfield Oil Corp., San Gabriel, Calif., to Long Beach; **Guy W. Staples,** engineer, Gulf Research & Development Co., Carlsbad, N. M., to Liberal, Kans.; **J. L. Wallace,** geologist, Apache Exploration Co., Big Lake, Tex., to Houston; **H. D. Christner,** engineer, Continental Oil Co., Bowie, Tex., to Arlington, Tex.

C. L. Berryhill, engineer, Gulf Refining Co., Burkburnett, Tex., to Stillwater, Okla.; **Richard A. Althouse,** engineer, Pan-American Refining Corp., Galveston to Texas City; **J. A. Stinson, Jr.,** engineer, Stanolind Oil & Gas Co., Houston to Tulsa; **L. F. Shiplet,** superintendent, The Texas Co., Midland, Tex., to Fort Worth; **J. F. Neill,** foreman, The Texas Co., Odessa, Tex., to Midland, Tex.; **Allen D. Acomb,** The Texas Co., New Orleans to Houma, La.

Vernon T. McGhee, engineer, Phillips Petroleum Co., Smackover, Ark., to Odessa, Tex.; **Ivan G. Burrell,** engineer, Ohio Oil Co., Bridgeport, Ill., to Marshall, Ill.; **M. R. Henderson,** geologist, Wiggins, Miss., to Biloxi, Miss.; **Gordon W. Knobeloch,** engineer, Standard Oil Co. (Ind.), St. Louis, Mo., to Jennings, Mo.; **Arthur M. Mahoney,** engineer, Shell Oil Co. Canada, Ltd., St. Louis, Mo., to Montreal, Que.

W. E. Ware, geologist, The California Co., La Junta, Colo., to Kemmerer, Wyo.; **N. C. Eakin,** superintendent, Mountain Fuel Supply Co., Coalville, Utah, to Rock Springs, Wyo.; **Gus Bealmear,** engineer, Baroid Well Logging Service, Riverton, Wyo., to Rock Springs, Wyo.; **H. C. Talley,** engineer, The Texas Co., Boise City, Okla., to Littlefield, Tex.; **G. E. Wegner,** foreman, Helmerich & Payne, Inc., Chickasha, Okla., to Marlow, Okla.; **Charles N. Hefner,** engineer, Mud Control Laboratories, El Reno, Okla., to Enid, Okla.

A. R. Ballou, engineer, Sun Oil Co., Tyler, Tex., to Dallas; **P. M. Thompson,** foreman, The Texas Co., DeRidder, La., to Alexandria, La.; **J. L. White,** engineer, Magnolia Petroleum Co., Eunice, La., to Mamour, La.

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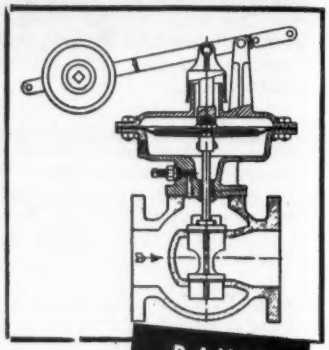

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Equipment Men in the News

Goodyear Company Makes Management Changes

Three important changes in the top management of The Goodyear Tire & Rubber Co. are announced by P. W. Litchfield, chairman of the board, following a meeting of the board in Cleveland. Cliff Slusser has resigned as vice president in charge of production and as a member of the board of directors. He will continue with the company as vice president and general manager of the subsidiaries which operate domestic textile plants and coal mines. Slusser is succeeded on the board of directors and as vice president in charge of production by Russell DeYoung, who has been vice president and general manager Goodyear Aircraft Corp., a subsidiary. Fred W. Climer was elected to a new vice presidency of the parent company in charge of industrial relations. He moves up from the position of assistant to the president where he has had charge of personnel and labor relations.

Bethlehem Supply Officials Visit Home Office

Bethlehem Supply Co. officials including G. A. Tompson, vice president; R. C. Ayers, general manager of sales; R. G. Petri, auditor and assistant secretary; A. W. Tarkington, assistant treasurer; J. F. Eaton, Tulsa plant manager, and I. C. Smith, Corsicana plant manager, have just returned from a trip East during which they visited the home office of Bethlehem Steel Corp. in Bethlehem, Pa. Ayers extended his trip to include other points in the East contacting the trade.

Holcomb New P&H Sales Manager

Harnischfeger Corp., Milwaukee, builder of P&H products, has announced the appointment of Ralph D. Holcomb as general sales manager. He will direct the sales of all P&H products, excavators, road machinery, hoists, cranes, and welding equipment. Holcomb's elevation to his new post follows 18 years of continuous service with the P&H organization. During this period, he has directed sales in many sections of the country, including Wisconsin, New York, Pennsylvania, Missouri, Tennessee, and California.

Stockland Named Sales Promotion-Advertising Manager

Consolidation of the FWD sales-promotion department and advertising department under the managership of M. O. Stockland, Jr., is announced by Four Wheel Drive Auto Co. Stockland has served as sales-promotion manager since the organization of that department early in 1946. The consolidation move came as a result of the retirement of Francis M. Higgins as advertising manager in order that he might devote all of his time to his work as president of the Wisconsin Central Airlines.

McCord Names Barter

P. L. BARTER

P. L. Barter, vice president of McCord Corp. for the past 23 years, has been elected to the newly created office of vice chairman of the board of directors, President A. C. McCord announces. Barter will continue to hold his present post as vice president of the corporation. He has been an officer of the corporation since the early twenties, and a member of the S.A.E. since 1913.

Endres Advanced in General Petroleum

Promotion of A. P. Endres to the post of assistant to the public-relations director of General Petroleum Corp. is announced by W. B. Curtis, public-relations director.

Texoma Expands Operations

Texoma Supply Co., operating as a proprietorship since its organization in October 1937, has been incorporated under the laws of Colorado, according to Carl J. Hochenauer, president and founder of the company. Other officers of the new corporation are Ray H. Smith, vice president, and Frederick T. Borgwald, secretary-treasurer, who with Hochenauer comprise the board of directors. Smith will also serve as general sales manager. The company recently moved into the Elliott Building at 120 East Ninth Street, Tulsa.

W. C. Norris Elects New Officers

At a recent annual meeting of the stockholders of W. C. Norris, Manufacturer, Inc., Edward C. Bolger was elected chairman of

E. C. BOLGER

W. L. BUTLER

the board, and William L. Butler, executive vice president. Bolger, for many years an executive with General Motors Corp., returned to the United States in the spring of 1946 after 4 years' service in the Navy, where he was a lieutenant commander. Butler, who has been with W. C. Norris since 1935 in various executive capacities, has been advanced from secretary-treasurer to his present new position.

Young Radiator Appoints Rademacher

Young Radiator Co., Racine, Wis., announces the appointment of Theodore C. Rademacher, Jr., as advertising and sales-promotion manager effective March 3. Rademacher was formerly assistant merchandising manager of the Massey-Harris Co., farm-machinery manufacturers of that city.

O.I.C. Enters Export Sales Market

Entry of The Ohio Injector Co., Wadsworth, Ohio, into the export sales market is being announced by the concern in communications to many firms who have indicated over the years a desire to handle the complete company valve line in the export trade. The company also announces appointment of M. W. Pauly as manager of the export division. His headquarters are 5940 Grand Central Terminal, New York.

Texasteel Names Distributor

Texasteel Manufacturing Co. announced that exclusive distribution of its products in Oklahoma and Kansas will be handled by Texoma Supply Co. This line of products includes electric-steel sucker rods, polish rods, and other subsurface production accessories. Texoma Supply Co. is an old established oil-well supply concern with headquarters in the Elliott Building, 120 East Ninth Street, Tulsa.

Sales representatives of National Tube Co., U. S. Steel subsidiary at a general postwar meeting in Dallas on January 29

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SPUDDER—Fort Worth Spudder D located on siding in Tulsa. Travco Equipment Co., 110 Midco Bldg., Tulsa, Oklahoma. Phone 5-2251.

FOR SALE: 25—94′ A.P.I. Angle Iron Drilling Derricks erected at Pampa, Texas, 333,000# capacity, $550.00 each. Cities Service Oil, Patridge, Bartlesville, Oklahoma.

FOR CABLE TOOLS
see
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Box 107. Red Fork Station. Tulsa, Oklahoma

FOR SALE

1—26 Bay 14 Louvres Marlin Cooling Tower constructed new in 1942, all red wood. Also natural gasoline storage tanks, heat exchangers, stills, dephlegmator, absorbers, pumps and all connections, all in A-1 condition.

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FOR SALE: Six New Kobe, 2½ inch tubing insert, pumps, one Triplex—Bargain for immediate sale. Ben Beckham, Jr., Box 134, Overton, Texas. Phone 3921.

TWIN 170 H.P. 4-cycle Miller Compressor, gas driven, also 50 H.P. Miller Compressor. P.O. Box 1889, or Phone 2-5158, Tulsa, Oklahoma.

LUMBER FOR SALE: 3x6 and wider 10 to 16 rough Oak $58.00 f.o.b. mill. E. J. Gaiennie, Lumber, Box 1074, Shreveport, Louisiana.

FOR SALE: Pumping Units. All types & sizes. New and used. Bridgeports, Jensens, Americans, Atlas, Ideco, with or without Power. Glenn Supply Co., 3600 Sand Springs Road. Phone 3-9607, Tulsa, Okla.

FOR SALE: Casing pulling unit with 6 cylinder International motor on skids, sand line drum double cathead. 6 cylinder thrift pump, 5½" telescope jacks 4½′ lift, steel mast pole, cat line and Wilson tongues, capable of pulling any depth well. Address P.O. Box 214, Henderson, Kentucky, or phone 2376 after 6 o'clock.

FOR SALE: Complete 5000′ drilling rig. Unit U-10. Draw works powered by two Caterpillar D 13,000 engines; Oilwell 14P pump; 94′ cantilever mast and substructure; 10 KW Diesel Light Plant; bunk house; tool house; 5,000 feet of 3½" drill pipe. Rig now running at Pettus, Texas. Falco Oil Well Service, Box 1255, Alice, Texas.

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254,400 ft.—¼"—6x7 High Grade Plow Steel Galv. Preformed.
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Manufactured by the Nation's leading wire rope companies.
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WELL DRILLING Machines, Spudders, Core drills, Standards. Complete stock cable tools. Used equipment reconditioned. Some Government surplus. Pressey & Son, Pueblo, Colorado.

OILFIELD TANDEM TRUCKS
Whites-International-Macks-Misc. full rigged for oilfield work or ideal for mounting heavy units or rigs. G. G. Clayton, Houston, Texas, P.O. Box 1671. Telephone Keystone 3-1361.

FOR SALE: One 7¼ x 10" and one 7¼ x 14" Gardner Denver pumps—overhauled—good condition. Also, one 82 CFT Gardner Denver Air Compressor. Drillers Machine Shop, Box 4532, Oklahoma City 9, Okla., Phone 6-3281.

FOR SALE: Small topping plant, capacity 150 barrels per day; pipe line gathering system and crude available; storage tanks and trucks. Address inquiries to Box B-637, The Oil and Gas Journal, Tulsa, Oklahoma.

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55—10,000 Gallon Capacity Tank Car Tanks

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2—Winton Model 1920	3 cyl 10"	x 14"	94 HP @ 300 RPM
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9—Winton Model 1580	3 cyl 14"	x 16"	170 HP @ 270 RPM
1—Busch 3DF17	3 cyl 13"	x 17"	175 HP @ 300 RPM
2—DeLavergne	4 cyl 14½"	x 13"	250 HP @ 270 RPM

PUMPS, HORIZONTAL DUPLEX RECIPROCATING

24—Prescott 6" x 24" capy.	20,000 bbls. per day	800#
13—Prescott 4⅝" x 18"	9,000 bbls. per day	800#

GENERATORS, DIRECT CURRENT

21—Allis Chalmers	25 KW	125 Volt	Belt Driven
2—Westinghouse	25 KW	125 Volt	Belt Driven
9—Allis Chalmers	15 KW	125 Volt	Direct connected to Model CSR6 gasoline engine

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